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## THE CAÑONS OF THE COLORADO. *

[Compiled from the Report of Prof. J. W. Powell, Geologist, in charge of the G. and G. Survey of the Territories.]

THE Colorado River of the West drains a vast system of plateaus. On these plateaus are lone mountains, short ranges, and groups of volcanic cones, and the principal affluents of the river have their sources in high mountains standing on the edge of the great drainage basin. There is no considerable valley along the course of the Colorado River, nor along any of its principal tributaries north of the thirty-fifth parallel. The streams run chiefly in deep cañons, and these divide the country into a series of plateaus of sedimentary rocks. The Colorado rises at from ten to twelve thousand feet above the sea. The whole region is arid, the mountains scantily clothed with vegetation, and the indurated rocks rarely masked with soil.

The principal mountain ranges are composed of metamorphic rocks, with unaltered sedimentary beds on their flanks. Some of the more western mountains are chiefly of the latter material. Altogether they constitute a geological province characterized by a great development of metamorphic crystalline schists, with patches and structural basins of marine and lacustrine sediments, and a complicated series of volcanic formations.

Southward from the Oregon line, through Western Utah, Nevada, Southeastern California, and perhaps in Western Arizona, numerous short and more or less distinct mountain ranges are found. The valleys and plains separating these ranges are covered with rather late sub-aërial gravels masking the underlying formations. The ranges are composed of metamorphic crystalline schists with Paleozoic beds on their flanks, sometimes consisting largely of Paleozoic materials, both complicated by eruptive beds. The little streams rising in these mountains empty into salt lakes or disappear in the sand.

The topographic features of the basin of the Colorado are in many respects unique. Mountains, hills, plateaus, plains, and valleys are here found, as elsewhere throughout the earth; but, in addition to these features, we find buttes, outlying masses of stratified rock often of great altitude, not as dome-shaped or conical mounds, but usually having angular outlines (see Fig. 9). Their sides are vertical walls, terraced or buttressed, and broken by deep re-entering angles. Then we find lines of cliffs of great length and great height, revealing the cut edges of strata swept away from the lower side. Thirdly, we find cañons, narrow gorges scores or hundreds of miles in length and hundreds or thousands of feet in depth, with walls of precipitous rocks.

In the arid region of the West there are tracts which are called *mauvaises terres*, or bad-lands. These are dreary wastes, crowded with naked hills with rounded or conical forms, composed of sand, sandy clays, or fine fragments of shaly rocks, with steep slopes, and, yielding to the foot, they are climbed only with the greatest toil. The hills are crowded together, and the waterways between are deep *arroyas*. Where the mud rocks, or sandy clays and shales of which the hills are composed, are interstratified with occasional harder beds, the slopes are terraced and the outlines are angular. This type of topographical features I have denominated Alcove Lands.

Let us present the various features of the country in geographical order, beginning at the north and following the river southward. By reference to the map it will be seen that the area embraced in the survey north of the Uinta Mountains is but small, and the general surface of the country is about a thousand feet above Green River, with here and there peaks rising a few hundred feet higher. The altitude gradually lessens to the foot of the Uinta Mountains. To the north the waterways are all deeply eroded; the permanent streams have flood plains, but the channels of the wet weather streams are narrow and much broken by falls. The rocks are sediments of a dead lake, and consist of thinly laminated shales, hard limestones, breaking with an angular fracture, crumbling bad-land rocks, and homogeneous heavily bedded sandstones. The scenic features are variable. On the cliffs about Green River City strange towers and buttes are seen. The limestones, interstratified with shales, give terraced and buttressed characteristics to the escarpments of the cañons and narrow valleys. The bad-lands are well shown by Fig. 10.

South of Bitter Creek there is a small district which we have named the Alcove Land. It is drained on the east by Bitter Creek—a permanent stream—and its intermittent tributaries. The crest of this watershed is only from two to four miles back of the Green River, but as it is usually more than a thousand feet above the latter, the streams have a rapid descent, and every shower-born rill has excavated a deep, narrow channel. The walls of these cañons are usually too steep to be climbed, and the beds of the streams are often so broken by falls as to be impassable in either direction. The whole country is cut into irregular, angular blocks, standing as buttresses, benches, and towers, separated by deep waterways and gloomy alcoves.

THE COLORADO RIVER. FIG. 9.—BUTTES OF THE CROSS.

These and similar Buttes, sometimes terraced with brilliant strata, yellow alternating with vermilion, or rising in regular columns, cover the country like ancient ruins.

Back some miles to the west of Green River, between Black's and Henry's Forks, there is a region of lead, buff, and chocolate-colored bad-lands. This bad-land country differs from the Alcove Land in that its outlines are everywhere rounded and flowing, as the rocks quickly crumble under atmospheric influence. An exposure of solid rock is rare, but loose incoherent sandstones, shales, and clays cover the surface; there is no vegetation. The same abrupt descent of the streams and the same deeply eroded system of waterways are here as in the Alcove Land. Occasionally thin strata of harder rock form shelves or steps upon the hillsides. Traces of iron and rarer minerals are found in these beds. The chemical action of the atmosphere has painted the rocks with various brilliant colors.

THE COLORADO RIVER. FIG. 10.—BAD-LANDS NEAR BLACK'S FORK. A Region of Loose Disintegrated Rock, destitute of vegetation.

South of the Uinta Mountains (which will be noticed hereafter) and back some distance west of the Green River is a district known in the Indian dialect as the Yellow Hills, which are carved from yellow, pink, and slate-colored clays and shales. Seen from an eminence, in the noonday sun, this region looks like a billowy sea of molten gold. These hills are low and rounded and destitute of vegetation. South of the Yellow Hills is a broad stretch of red and buff-colored bad-lands occasionally highly bituminous. Where the bituminous rocks occur the bad-land forms disappear and more or less vegetation is seen. Further south across White River these beds are interstratified with harder rock and the alcove forms reappear (See Fig. 11, page 1919).

Several hundred miles west of Green River are the Wasatch Mountains, running north and south. They send out a branch to the east called the Uinta Mountains, which, at their junction with the Wasatch, have the same altitude as the latter, and are covered with perpetual snow, but toward the east the Uinta peaks gradually diminish in height till they terminate in low hills on the east of the Green River.

Through this Uinta range the Green River flows in a series of cañons. To one studying the geography of this country, with no knowledge of its geology, it would seem strange that the river has cut through the mountains when it might have passed round them to the east. The first explanation suggested is that it followed a previous fissure in the range. This theory is unsatisfactory, for there is abundant evidence that the river has cut its channel, and the question returns, How could it cut its way through a range thousands of feet above its surface? The answer is, The river was running ere the mountains were formed. The contraction of the earth started a fold of the strata athwart the river's course. Had it been suddenly formed the obstruction would have diverted the river to the east beyond the extension of the wrinkle, but the rising of the fold was little or no faster than the corrasion of the river channel. The river did not cut its way *down* through the mountains, but, preserving a level little or no greater than its present bed, as the fold was lifted it cleared a cañon, and the mountains rose on either side. As the saw remains stationary while the log it cuts advances, so the river was the saw which cut the rising mountains in two.

Ere this great fold was elevated, there were beds of sandstone, shale, and limestone, 25,000 feet thick, lying horizontally over a broad stretch of this country. Then the summit of the fold slowly emerged, till the lower beds were lifted to the original altitude of the upper beds, and if the latter had not been carried away, there would be a billow of rock more than a hundred miles long, fifty miles wide, and twenty-five thousand feet higher than the river, gently rounded to either side. But, as the rocks were lifted, rains fell and gathered into streams, and the incessant corrasion cut the fold down almost as fast as it rose, so that the present inconsiderable height above the original level indicates the amount of denudation.

Not only do mountains form clouds about their tops, but the clouds form the mountains. Lift a region of granite or marble into the upper air, and they gather about it and hurl their storms against it, beating the rock into sand, and carving cañons, gulches, and valleys, leaving the mountains between.

The Uinta uplift has brought up all of the mesozoic and carboniferous groups with the Uinta sandstone; and in one locality a still older group of rocks, the Red Creek quartzite, is exposed. On the flanks of the range, both north and south, cenozoic groups are found.

The locality where the Red Creek quartzite is exposed is in the vicinity of Red Creek, a small tributary of the Green River, emptying into the latter at the western end of Brown's Park. The group embraced under the name is the lowest horizon found within the region under discussion. It is composed in great part of a very crystalline white quartzite, intimately associated with which are very irregular aggregations of hornblendic and micaceous schists, the latter sometimes bearing garnets. Its relation to the Uinta sandstone above it is seen in several localities. Other facts relating to the junction of the two groups are observed on the summit of Quartz Mountain. These facts are as follows: A part of the Uinta group, which is later and higher, terminates abruptly against the quartzite. The thickness of the beds thus limited is about 8,000 feet, and as the beds are traced from the southward to this point of junction they rapidly change from finer to coarser sediments, often appearing as conglomerates in the vicinity of the quartzite. The total thickness of the beds is not increased in the transition from finer to coarser sediments. In these conglomerates the coarser materials are quartzite, hornblendic rock, etc., similar to the Red Creek group, held in a matrix of siliceous, hornblendic, and micaceous sands, which are quite ferruginous. The position of the quartzite is on the flank of the great Uinta flexure, not its axis, and from two to three thousand feet of the upper members of the Uinta sandstone were

* Continued from page 1871, SUPPLEMENT No. 118.

deposited over the summit of the quartzite. From these facts we may safely infer that this was a great headland of quartzite standing out into the old Uinta Sea. About 10,000 feet of the Uinta sandstone was deposited against the old headland before it was buried by the upper members of the Uinta group. Hence this headland must have been at least 10,000 feet high. But, doubtless, the quartzite itself was steadily wasted by erosion above quite as rapidly as it was buried below, and this leads to the conclusion that the headland was 20,000 feet high before the lowest known member of the Uinta sandstone was deposited. We may thus restore in our imagination a mountain more gigantic than any now remaining in North America, its base washed and cavern-carved by that ancient sea. Geologists have concluded that quartzite and schistic rocks were originally accumulated as sediments, and subsequently metamorphosed. In this group the metamorphism was accomplished before the deposition of the sandstones, for the sandstones are composed of material denuded from the metamorphic group. But the sandstones are of great thickness, and underlie unconformably an extensive series of carboniferous rocks. From this we infer that the quartzite is of great geological antiquity.

The great mass of the Uinta range is composed of sandstones of this group. Intercalated with the sandstones are some arenaceous shales. The whole group is exceedingly ferruginous. The general color of the walls of cañons and escarpments is red and brown. Ripple marks, mud rills, and rain-drop impressions are abundant. No fossils have been found.

Flaming Gorge is the point where the river strikes the flank of the Uinta fold, and here the rocks dip to the north, and the course of the stream is against the inclination of the beds. The axis of the fold is not crossed till after passing through Red Cañon. From the foot of Red Cañon to the Gate of Lodore, a distance of more than thirty miles, the river runs through a valley known as Brown's Park, five or six miles wide, and inclosed by mountains. It is a curious fact that the central line of this valley corresponds to the axis of the fold, that is, had the fold been made without erosion, the summit would have been above the deepest part of the park.

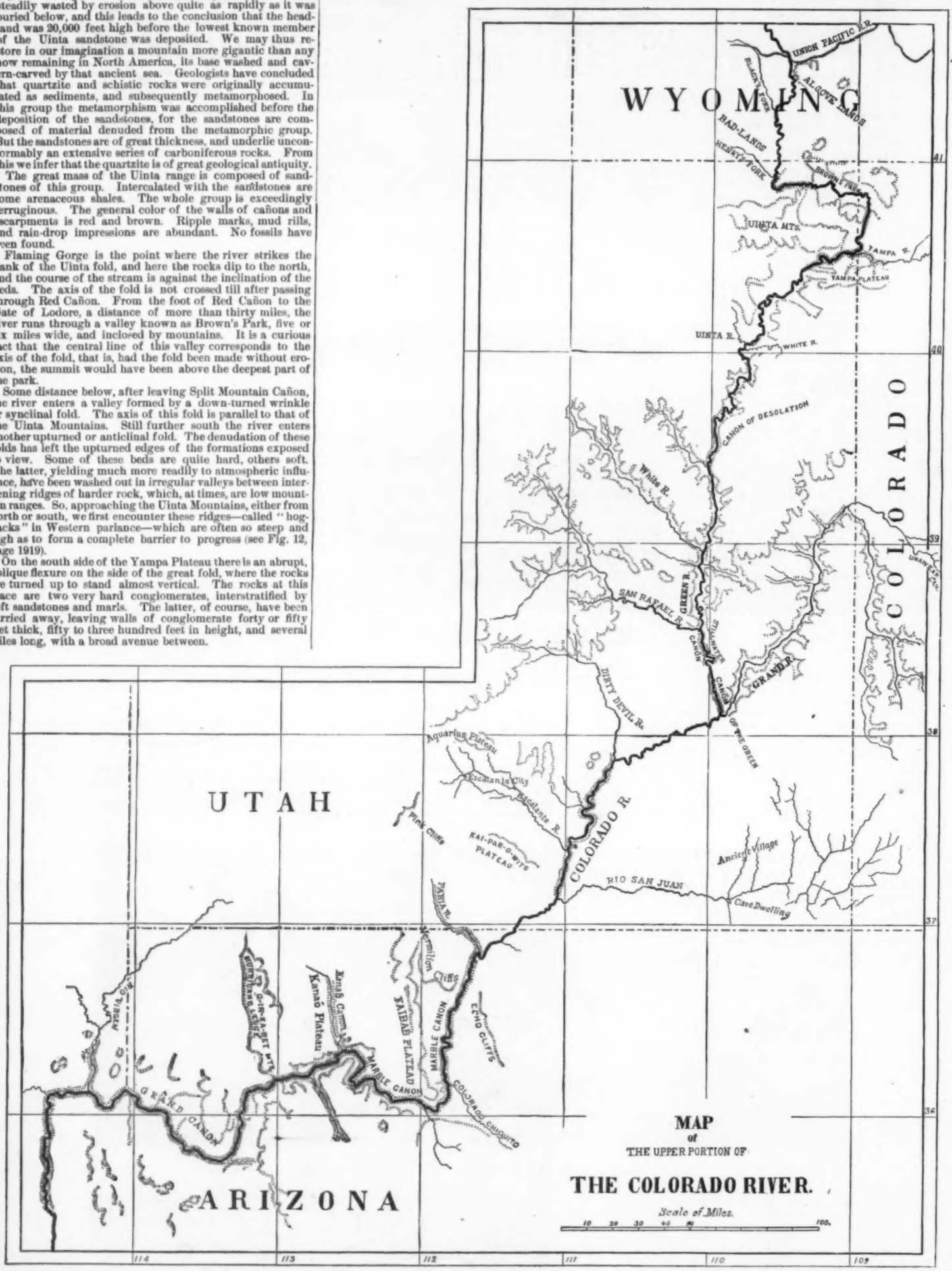
Some distance below, after leaving Split Mountain Cañon, the river enters a valley formed by a down-turned wrinkle or synclinal fold. The axis of this fold is parallel to that of the Uinta Mountains. Still further south the river enters another upturned or anticlinal fold. The denudation of these folds has left the upturned edges of the formations exposed to view. Some of these beds are quite hard, others soft. The latter, yielding much more readily to atmospheric influence, have been washed out in irregular valleys between intervening ridges of harder rock, which, at times, are low mountain ranges. So, approaching the Uinta Mountains, either from north or south, we first encounter these ridges—called "hog-backs" in Western parlance—which are often so steep and high as to form a complete barrier to progress (see Fig. 12, page 1919).

On the south side of the Yampa Plateau there is an abrupt, oblique flexure on the side of the great fold, where the rocks are turned up to stand almost vertical. The rocks at this place are two very hard conglomerates, interstratified by soft sandstones and marls. The latter, of course, have been carried away, leaving walls of conglomerate forty or fifty feet thick, fifty to three hundred feet in height, and several miles long, with a broad avenue between.

longitudinal valleys there are also three varieties, namely, *anticlinal* valleys, which follow anticlinal axes, *i. e.*, axes of upraised folds; *synclinal* valleys, following synclinal axes, *i. e.*, axes of down-turned folds; and *monoclinal* valleys, which are equivalent to the hog-back valleys already described.

All these varieties and compounds of these varieties are

having been lifted and truncated prior to the exposure of the rocks further from the axis, the strata present their edges to the action of the elements, and the softer strata, not being protected by the harder, as they are where the dip is less, denudation progresses more rapidly. Second, the mountains, with their peaks in the clouds, condense their mois-




The drainage of the hog-back valleys is not always along their length; there are numerous transverse streams cutting through the ridges. The relations of the streams to the dip of the rocks is very complex. There are *transverse* valleys, having a direction at right angles to the strike; and *longitudinal* valleys, lying parallel to the strike. Of the transverse valleys there are *diaclinal* valleys, or those running through a fold; *cataclinal* valleys, which follow the direction of the dip; *anaclinal* valleys, which run against the dip. Of the

to be found among the cañons of the Green and Colorado, in the space of less than a hundred miles, so complex is the structure of this region. Thus Red Cañon is obliquely anaclinal; Brown's Park is anticlinal; the Cañon of Lodore is cataclinal; Summit Valley is monoclinal, etc.

There is a very interesting fact in relation to these inter-hog-back valleys. Their floors are lower than the general surface of the country further back from the mountains. There seem to be two causes for this. First, the great fold

ure, and the region of country adjacent is washed by more rain than that beyond. This increase of the denuding agency, with the increased liability to denudation, explains why the lowest country is at the foot of the mountains.

As before intimated, the drainage of the country was established before the folding of the strata, and the directions of the larger streams are entirely independent of the present topography

The valleys of this original drainage system we

THE COLORADO RIVER. FIG. 11.—ALCOVE AND BAD-LANDS SOUTH OF THE UINTA MOUNTAINS, CALLED THE YELLOW HILLS.
This Region in the noonday sun looks "Like a Billowy Sea of Molten Gold."

may call *antecedent*, adding another to the varieties of valleys found in this region.* In other parts of the mountain region of the West are valleys having directions *dependent* on corrugation. These may be styled *consequent valleys*.

THE COLORADO RIVER. FIG. 12.—HOG-BACK VALLEYS NEAR THE UINTA MOUNTAINS.
These Ridges sometimes rise to a height of a thousand feet.

A few miles south of the mouth of the Uinta River the Green enters the Cañon of Desolation, the walls of which steadily increase in altitude to its foot, where they terminate abruptly in the Brown Cliffs; the river immediately enters Gray Cañon, with low walls gradually rising till they end in like manner in the Book Cliffs, running in a direction transverse to the river. Likewise the walls of Labyrinth Cañon are low above, and increase in height as the river descends till the Cañon is terminated by the Orange Cliffs. (See Fig. 13.)

Thus, in ascending the river three great plateaus inclining toward the north are traversed, forming three geographic terraces many hundred feet high and many miles wide. The lower step of this great stairway, the Orange Cliffs, is more than 1,200 feet high, and the step is two or three score miles in width. From the Orange Cliffs north to the Book Cliffs is a gradual descent till the foot of the latter is not more than 100 feet higher than the foot of the Orange Cliffs. The Book Cliffs are about 2,000 feet high, and the terrace above about twenty miles wide. This terrace likewise descends till at the foot of the Brown Cliffs it is but 200 feet higher than the foot of the Book Cliffs. The Brown Cliffs are more than 2,000 feet high, and the plateau above gently descends to the valley of the Uinta River. The traveler in passing north apparently ascends over 5,000 feet, but in reality climbs but a few hundred, for the stairs are tipped backward.

The rocks through which Labyrinth Cañon is cut extend back under the beds of Gray Cañon, and these run back beneath the Cañon of Desolation. At one time the Desolation and the Gray Cañon strata extended over the Labyrinth Cañon strata, but they are washed away. It was explained how the unequal erosion of upturned strata surrounding the Uinta Mountains formed the hog-backs. Such ridges are seen when the dip of the rocks is at a high angle—from twenty to forty-five degrees; but where the dip is from one to five degrees the cut edges of the strata form steep cliffs. If the Uinta fold were depressed till the dip was almost imperceptible, the inclined ridges would become vertical cliffs and would occur at much greater distances from each other.

In the three cañons are rocks belonging to three distinct geological periods. In the Cañon of Desolation are tertiary sandstones; in Gray Cañon, cretaceous sandstones, shales, and impure limestones; between the head of Labyrinth Cañon and the foot of Gray Cañon rocks of cretaceous and Jurassic age are found, but they are soft, and have not withstood the action of the water so as to form a cañon. The Brown Cliffs are apparently built of huge blocks of rock, plainly exhibiting the lines of stratification. The beds are usually massive and hard, breaking with an angular fracture. The cliffs are very irregular, set with crags, towers, and pinnacles. The upper beds of the Book Cliffs are like those described, and they form a cap to extensive laminated beds of blue shales, in which, along the line of the cliffs, are curious effects of rain sculpture. The whole face of the rock is set with buttresses, and these are carved with a fret-work of raised vertical lines. Labyrinth Cañon is cut through a homogeneous sandstone. The cliffs in which it terminates consist below of rounded buttresses and mounds and hills of sand, above of columnar structure, and sometimes great columns appear fluted.

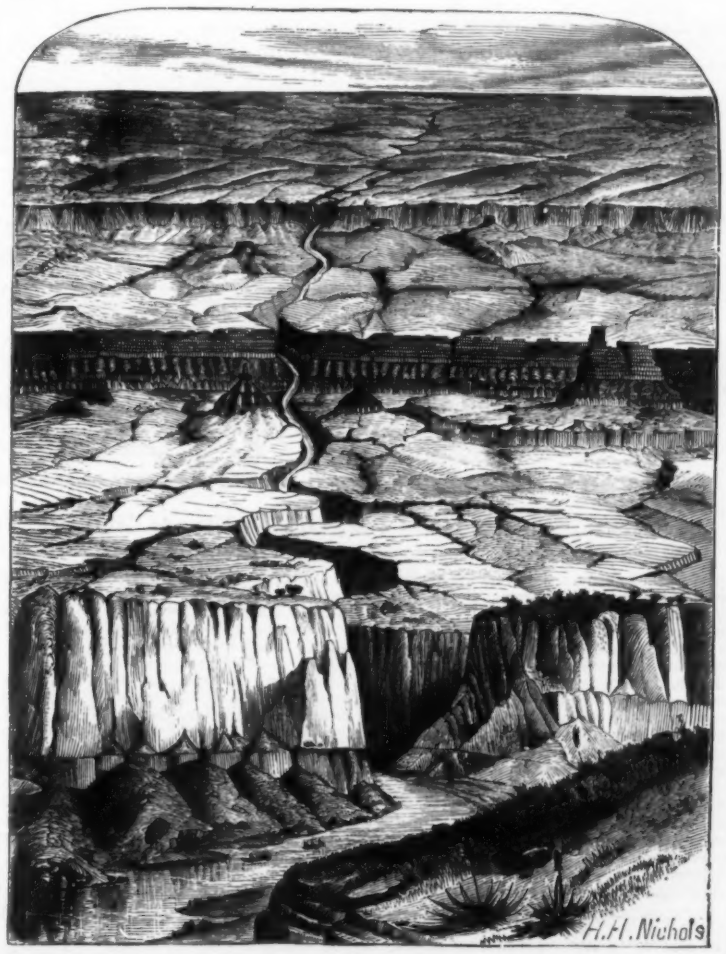
If the formations composing these several lines of cliffs extended over the strata now exposed, it is not easy to perceive why the rains falling equally over the whole surface should not wear the country down comparatively level. The formation of abrupt cliffs by the rain is explained as follows:

The climate is exceedingly arid and the scant vegetation forms no protection against the beating storms. Though but little rain falls, what there is has an eroding action difficult to conceive by one who has studied the degrading action of water in a country covered with grasses, shrubs, and trees. In a country well supplied with rains, and having abundant vegetation, the water penetrates the soil and disintegrates the underlying solid rock as fast or faster than it is washed away by the rains, and the indurated rock has no greater endurance than the more friable shales and sandstones. But in a dry climate the softer rocks are soon carried away where the edges of strata are exposed, while the harder are undermined and break off in steep fractures, and falling upon the plain below are broken into pieces which the rain more readily disintegrates or carries away. Occasionally the ever-retreating and irregular line of cliff isolates a portion of the terrace and thus buttes are formed. Looking from the Book Cliffs over the plain below, vast numbers of buttes are seen scattered over scores of miles, each so regular and beautiful that one can scarcely cast aside the belief that they are works of Titanic art. It seems as if a thousand battles had been fought on the plain below, and on each field the giant heroes had built a monument. But no hand has placed a block in these wonderful structures; the rain-drops of unreckoned ages have cut them all from the solid rock.

The summit of the high plateau through which the Cañon of Desolation is cut is fretted into pine-clad hills with nestling valleys and meadow-bordered lakes between, for to this upper region the clouds impart abundant moisture. In the meadows herds of deer range. Huge elk, with heads bowed by the weight of ragged horns, feed among the pines, or crash with headlong speed through the undergrowth at the report of the rifle.

The river successively traverses Stillwater, Cataract, and Narrow Cañons. Along the general slope on each side are numerous buttes, which are often standing columns. From them the Indians named the region *Toom-pin, Wu-near, Tu-weap*, or Land of Standing Rocks.

*(To be continued.)*




THE COLORADO RIVER. FIG. 13.—ORANGE CLIFFS IN FOREGROUND, 1,200 FEET HIGH.
Between these Cliffs and the Book Cliffs, in the middle ground, the terrace is from 40 to 60 miles wide. The next terrace is 20 miles wide and the Book Cliffs and the Brown Cliffs, the latter in the background, are about 2,000 ft. high.

* As there are no extended geological charts published of this region, we can only enumerate the geological features without locating them.

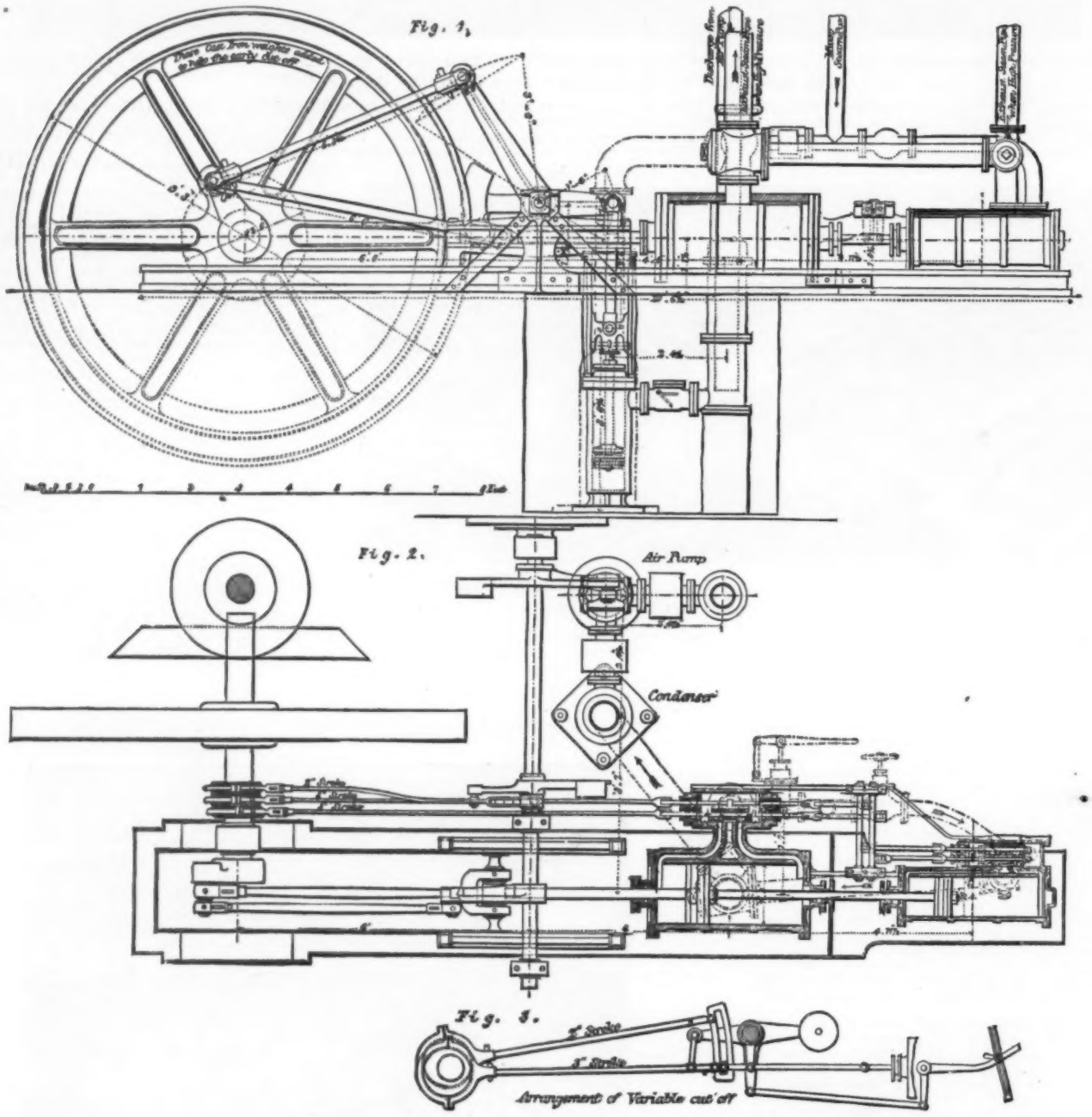
## COMPOUNDING A HORIZONTAL ENGINE.

The annexed illustrations show a mode of compounding an existing horizontal non-condensing engine as carried out by Mr. Thomas Urquhart, the locomotive superintendent of the Graizi Tzaritzin Railway, Russia, in the case of an engine at the works of that railway company at Borisoglebok. The engine in question had originally a cylinder 15 ins. in diameter, with 30 in. stroke, and it was supplied with steam from a Cornish boiler 20 ft. long and 6 ft. 6 ins. in diameter, the boiler also furnishing steam to a 10 cwt. steam hammer. The demands upon the engine increasing as additional machinery was put to work, the steam supply ultimately became insufficient, and it was to meet this state of affairs and to avoid the cost of putting down additional boiler power that Mr. Urquhart determined to compound the engine and to make it condensing.

The engine, we should state, is situated under a large water tank 30 ft. by 12 ft. by 10 ft., which supplies the locomotive depot and station generally, the water being pumped into this tank from the river by a separate engine. When the engine we illustrate was compounded, the water in this tank was utilized for condensing water, and the air pump was made to discharge its water into a second elevated tank from which a supply of warm water is drawn for the use of the locomotive depot, etc.

The manner in which the compounding of the engine was effected will be readily understood from our engravings, a second cylinder 10 ins. in diameter being fixed in the rear of the existing one on an extension of the bed-plate, and an air pump and condenser being added as shown. The mode of working the air pump is peculiar, but suits this particular case well. The steam and exhaust pipes are arranged so that the engine can be worked non-condensing when required.

Mr. Urquhart informs us that the result of the alteration, which was made in 1873, has given very satisfactory results, the boiler now giving an ample supply of steam, and there being a reduction of 25 per cent. in the fuel consumption. A vacuum of 10 lbs. is obtained in the low-pressure cylinder, this vacuum increasing to 13 lbs. when the engine is working with a light load only.—*Engineering.*




## COMPOUNDING A HORIZONTAL ENGINE.

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The building of a narrow gauge railroad from Buffalo to Albany, on the tow-path of the Erie Canal, is the last enterprise in the railway line seeking for capital and a charter. The distance is 668 miles, and the capital is $668,000—$1,000 a mile! The ostensible purpose is said to be the towing of the canal boats with small engines of 20 horse power

## PIPES FOR PLUMBING.

By T. M. Clark.

Of these we have now in common use the plain lead, tin-lined lead, and block-tin, all made by drawing the metal over a mandril; the seamless brass pipes, drawn in a similar manner; and pipes of wrought-iron, with welded seams, plain, tin-lined, enameled, rubber-coated, and galvanized. All these are used for supply pipes, and each has its merits and defects, somewhat as follows:

The lead pipe is the most generally used, and is convenient to work with, moderately cheap, and has the merit of yielding somewhat, so that it may freeze and thaw without bursting, and when a rupture does occur it is usually only a small hole.

The grand defect of lead for pipes is its solubility in water. Well-water generally contains a little dissolved carbonic acid, and sometimes sulphate of lime, either of which will soon coat the inside of the pipes with an insoluble crust of carbonate or sulphate of lead, after which the metal no longer affects the water in ordinary cases; but river or pond water dissolves the lead slowly, and rain-water, which often contains a little nitric acid, quite rapidly, and the solution so formed is poisonous. In practice, the soft water supplied in cities is seldom affected to a serious extent unless it has been allowed to stand a long time in the pipes; but rain-water is often so affected, and it is safest, where rain-water is used, to avoid the use of lead.

In order to prevent the contact of the water with the poisonous metal, pipes are made by fixing a lining of pure tin inside the lead for making the pipes, and drawing them out together, thus coating the inside with about one-fiftieth of an inch of tin, which is unaffected by water.

This tin-lined pipe is admirable in itself, and it is sometimes claimed that although it costs about sixty per cent. more per pound than the common lead pipe, the tin lining strengthens it so much that a pipe of about half the weight can be used, making the cost about the same; but in practice the tin-lined pipe is usually put in of the same weight as lead pipe in a similar situation. Nothing, however, is perfect; and it is found that in soldering the joints of the tin-lined pipe, the heat of the solder sometimes melts the coating of tin, which is very fusible, thus exposing the lead, and the galvanic action between the two metals causes the lead to dissolve in the water, occasionally to a serious extent.

The block-tin pipe is very costly, and is used only for the portions of pipe immersed in the water of cisterns or tanks, or for conveying ice-water or beer.

Plain iron pipes are little used for house-plumbing, for the obvious reason that they would soon fill with rust. They are protected by boiling in tar, which makes a cheap pipe, but retains a tarry flavor for a long time; or by a coating of black enamel; or by coating them inside and out with vulcanized India-rubber; or by galvanizing, that is, dipping them in melted zinc.

The enameled pipes are made in several places, the rubber-coated only by Morris, Tasker & Co. They are equally durable and good for their purpose, though the appearance of the red rubber-coating is, if anything, rather pleasanter than the enamel.

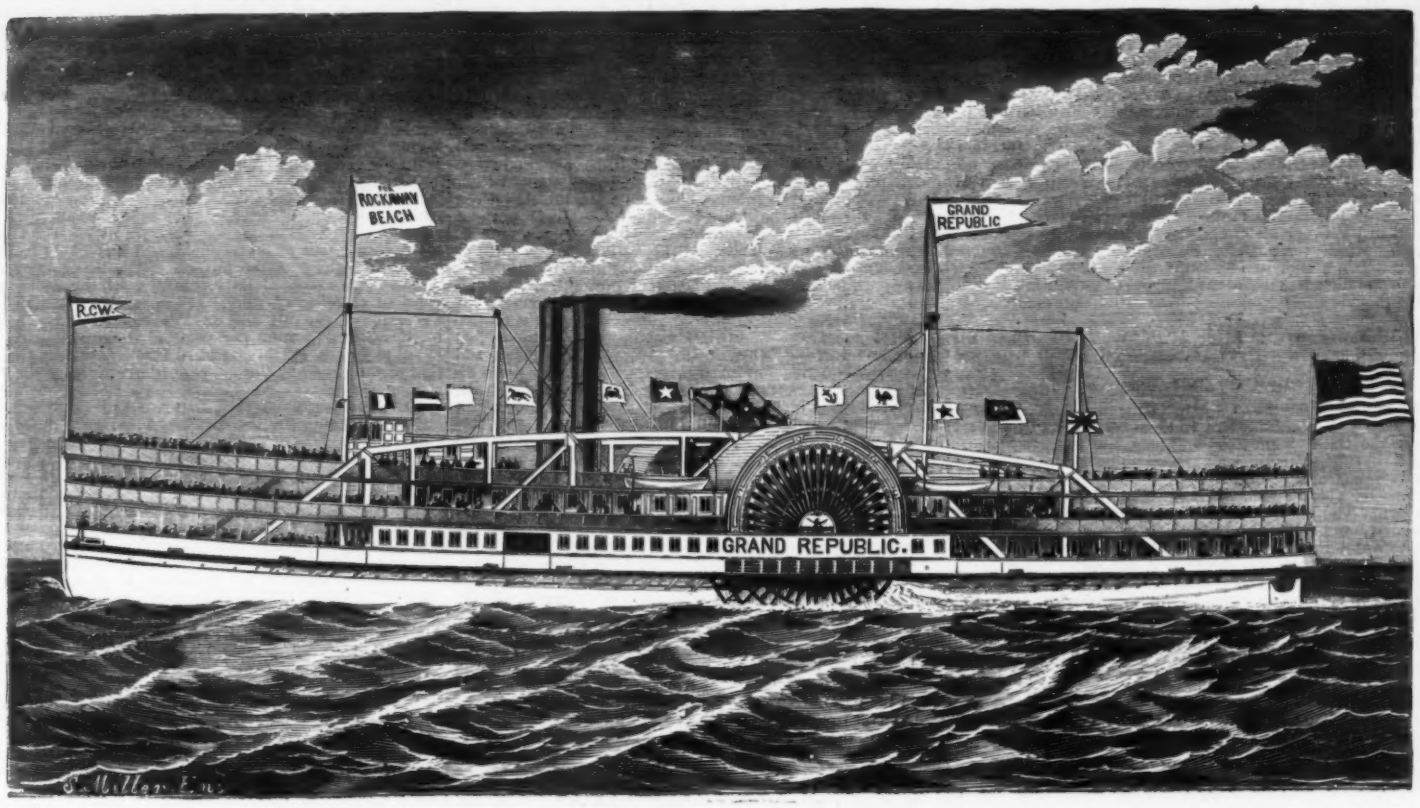
The galvanized pipes are strong and durable for public buildings and other situations where roughly used, but their appearance is not attractive.

The cost of the enameled, rubber-coated, and galvanized pipe is about the same; and each variety has couplings, branches, etc., which should always be of malleable iron for pipes of sizes used in plumbing, coated to correspond with the pipe. These are screwed together with red or white lead, precisely like gas or steam pipes; and all the varieties of pantry, bib, and basin cocks can be obtained with screws to fit them, so that no solder is used in jointing them. These pipes are so cheap, and the putting together so easy, that their use is economical, the average saving in house-plumbing by employing them instead of lead being eight or ten per cent.

There is another more expensive iron pipe, made in Philadelphia, and lined with a tin pipe, which is inserted and forced so strongly against the iron as to adhere quite perfectly to it. The connections are made by cutting away the tin from the joint and inserting a brass ferrule, tinned, and screwing up tight; the sharp edges of the ferrule force their way so firmly into the tin lining as to make a water-tight joint.

All the forms of protected iron pipe are liable in time, from careless workmanship, or the strain of contraction and expansion, or natural wear, to lose the protection in certain places; and when the water has once reached the iron, the pipe soon fills partially or entirely with rust. There may also be imperfections in the fittings, and if these or the joints should leak, the defect is not so easily stopped as in a lead pipe, and the freezing of a pipe opens a long seam, which will cause a flood when the water flows again.

With either iron or lead pipes for the cold water, it is well to have brass for the hot water pipes. The alternations of heat and cold strain the joints of the iron pipes so that a small opening is likely soon to be made in the enamel or other coating, exposing the pipe to rust. With lead, the




## THE NEW STEAMBOAT GRAND REPUBLIC.

expansion of a portion of pipe running horizontally, say across the kitchen ceiling, bends it slightly downward, unless very carefully supported; and when it cools, the contraction, instead of drawing the pipe back to the horizontal, stretches the metal a little. The next flow of hot water extends the pipe again, and it bends still further down, and so on until a "bag" is formed, which cannot be emptied when the water is drawn off from the house. The stiffness of the brass pipe prevents any such action, but the strain on the joints is so severe that they will sometimes leak. However, the advantage in using them is considerable, although they do not usually make so neat a job as the lead pipes.

Lead pipes are sold by weight, a ¾-inch pipe weighing two pounds, three pounds, or more or less, per foot, according to the thickness of the metal. In general, for supply-pipes the thickness of the metal should not be less than $\frac{1}{10}$ of an inch, which will give for a ¾-inch pipe a weight of about three pounds per foot, and for a ½-inch pipe about two pounds. With a heavy pressure the thickness must be greater, especially in the larger pipes.

The metal of iron and brass pipes is about $\frac{1}{12}$ or $\frac{1}{14}$ of an inch thick. They are sold either by the foot or by the pound, brass pipes more commonly by weight, and iron by length. In ordering pipes it should be remembered that brass pipes are classed according to their outside diameter, iron and lead by the inside diameter, so that the caliber of a ¾-inch brass pipe is less than that of a $\frac{5}{8}$-inch iron or lead pipe.

For waste-pipes, lead about $\frac{1}{10}$-inch in thickness of metal is commonly used, up to two inches in diameter. For two inches and larger, cast-iron is generally preferred in this country, on account of its stiffness, which keeps it perfect where a large lead pipe will lose its form and tear away from its connections by its own weight. There is a great difference in cast-iron pipes, some having the metal thicker on one side than the other, with other defects of imperfect casting. The only safety is to procure them of known and trustworthy makers or dealers. The thickness of the iron in two, three, and four-inch pipes should not be less than $\frac{1}{8}$ of an inch. Heavier pipes are advised by many engineers, but not commonly used.

The two-inch pipes are used for bath and sink wastes, and four or four-and-a-half-inch for soil-pipes. Three-inch are seldom used in houses. It is a great mistake to use waste-pipes too large for their purpose. If two inches is sufficient diameter to give a sink waste which will not be obstructed, four or five sink wastes may join the same two-inch pipe at different points of its course, and the pipe will carry off the discharge of the whole, even if they should all run full at once. Where the drain within the house walls is of iron, a six-inch pipe is generally used, and is perhaps safest where it receives two or three soil-pipes and a rain-water pipe, which may all be running full at once, although a smaller pipe would keep itself clean better. Two waste-pipes should never join at right angles, in either a vertical or horizontal plane. If they approach at such an angle, the junction must be made with a bend and a Y branch, the small end of the Y pointing down the current. This costs a dollar or so more than the right-angled junction, but is necessary to prevent obstruction.—*American Architect.*

## THE NEW STEAMBOAT GRAND REPUBLIC.

THE largest excursion steamboat ever built in this country was recently launched from Messrs. John Englis & Son's shipyard, at Greenpoint, L. I., opposite New York city. She is the sister ship of the Columbia, which was built by the same parties during the early part of last year for the R. Cornell White line of excursion steamers that ply during the summer between New York and the Rockaway seashore, a favorite summer resort. The length of keel of the Grand Republic is 285 feet; length on deck, 300 feet; breadth of hull, 41 feet; breadth on deck, 72 feet; depth of hull, 13 feet. She is built mostly of white oak, locust, and yellow pine, and the weight of materials in the hull is estimated to be about 1,350 tons. The machinery, constructed at the Quintard Works in this city, consists of a beam engine of the American type and two boilers. Dimensions of these are as follows: Diameter of cylinder, 76 inches; stroke, 12 feet; wheels, 36 feet diameter; each wheel has 32 paddles, 10½ feet face. Boilers two in number; length of each, 27 feet; front, 13½ feet; diameter of shell, 11½ feet; 6 furnaces; 2 smokestacks; tensile strength of boiler iron, 51,000 pounds; hydrostatic pressure applied by inspectors, 75 pounds to the square inch; steam pressure to be carried, 30 pounds; capacity of boilers, 50 tons of water. The boilers will carry water condensed from salt water by Lighthall's process. The draught of the Grand Republic is about 7 feet. Her great size and number of decks will allow her to carry 4,000 passengers, and her speed will be, it is estimated, twenty-two miles an hour.

## H. M. S. IRIS.

THE records of experiments in screw propulsion contain little to parallel the anomalous results obtained with the twin-screw dispatch vessel Iris. This ship was intended to attain a velocity of 17·5 knots an hour with 7000 indicated horse-power. She was built on lines suggested by Mr. Froude as the result of an elaborate inquiry into the laws of fluid resistance to floating bodies, and it was anticipated that every expectation formed concerning her would be realized. When she was tried on the measured mile for the first time, although her engines worked up to 6880-horse power, the ship reached a speed of but 16·45 knots; and as the speeds vary about as the cube roots of the powers, it was evident that a power of about 8250 horses was the least that would suffice to drive her at 17·5 knots an hour, which power could not be got from the engines. Much disappointment was felt, and various explanations were put forward to account for the shortcomings of the ship. It is generally known that twin screws are not on the whole so efficient as single screws, because they cannot be used without some arrangement to carry them outboard, either in the shape of wrought iron brackets or stern tubes, or both, and these appurtenances obviously increase the resistance of the ship. But for this Mr. Froude allowed in his calculations, or, more properly speaking, it was assumed that the lines which he had laid down for the ship would prove so excellent that notwithstanding the presence of stern tubes, the Iris would steam as fast, power for power, with twin screws as if she had been fitted with one screw. We have seen that this theory was hardly supported by the earlier trials of the ship. It was also suggested that the screws themselves were in fault, and that they would prove more efficient with two blades each than with four blades. Little could be urged in favor of this theory. An eminent authority has stated that between the best and the worst formed screw there is not ten per cent. difference in efficiency, the pitch being the same. In normal practice it is known that propellers, whether they have four, three, or two blades, are about equally good, and that the number of blades is settled as a rule by considerations which have little or nothing to do with efficiency, but refer to vibration and its prevention more than to anything else. To assert, therefore, that much improvement would be effected by taking two blades off each screw of the Iris appeared preposterous. Indeed, there was some reason to think that quite as much would be lost by augmented slip as could be gained in any direction. However, the experiment would cost very little, and so it was made, with, as we have said, results which are, we believe, without any parallel. The second speed trial of the ship took place on Friday, the 14th of February. We have already published the figures, but for convenience we reproduce them here—giving, for simplicity's sake, only round numbers concerning the engines. On the first trial, the engines making 43 revolutions per minute indicated 768-horse power, and the speed of the ship was 8 knots. On the second trial, with 45 revolutions, and 604-horse power, the speed was 7·95 knots, or practically the same as on the first trial. Thus, 164-horse power were saved. On the first trial, with 65 revolutions, and 2561-horse power, the speed was 12 knots. On the second trial, with 65 revolutions, the power was 1661, and the speed 11·759. Here a loss of less than a quarter of a knot an hour was accompanied by a saving of as much as 900-horse power. On the first trial, with 82 revolutions, and 5210-horse power, the speed was 15·123 knots; on the second trial, with 81 revolutions, the power was 3335, and the speed 14·507 knots. Here we have a loss of 0·616 of a knot, and a reduction of 1875-horse power. Finally, in the last trial, with 89 revolutions, and 4400-horse power only, a speed of 15·726 knots was obtained. As it was not considered advisable to run the engines faster than 89 revolutions per minute, the experiment terminated here. It will seen that a velocity less by ·724 knots than that realized with four-bladed screws was obtained with the altered propellers, with 2480-horse power less. If the two-bladed screws prove equally efficient, when their pitch has been altered from 18 ft. to something sharper—which will permit the engines to work up to a higher power without making more than 88 or 90 revolutions—the intended speed of 17·5 knots should be obtained with about 6200 indicated horse-power, or, say, 2000-horse power less than would have been demanded by four-bladed screws.

An examination of the figures will show that the results are somewhat lacking in uniformity. Thus, if we take the first pair of experiments, it will be seen that very little if any advantage was gained. The speed with the two-bladed screws was slightly less than when four blades were used, and the power was also less. Setting the two against each other, it may be said that no advantage whatever was gained by the change; and had the experiment ended here—as it might very well have done had it been carried out with a cargo steamer instead of what is intended to be the fastest ship in the British Navy—it would have been taken as proved that there is nothing to choose between four blades and two blades. The facts are instructive, as showing how easy it is to draw erroneous conclusions from incomplete data. In the second series of experiments, the power with two-bladed screws was 1661 for a speed of 11·76 knots. Had the speed been 12 knots the power would have been about 1750-horse power, so that the true saving amounts to 811-horse power. Here the gain is enormous, and, as we go on step by step, so does the benefit increase, and it thus becomes evident that what holds true of screws running at slow velocities by no means holds good for screws revolving rapidly. Again, it will be seen that, notwithstanding the loss of one-half the propelling area of the screws, the slip was not increased to any serious extent. Thus, at 8 knots the engines made but two revolutions per minute more with the reduced screws than they did with the unaltered propellers. The slip was thus augmented 36 ft. per minute, or less than one-third of a knot per hour. At 12 knots the slip was but slightly augmented. Practically it may be said that no loss of any kind worth mentioning ensued from the change.

We are thus brought face to face with the fact that the four blades which were removed required nearly 2000 indicated horse-power to work them, and we have to consider in what way this enormous power was expended. The problem is one far from easy of solution. It is impossible to maintain that it was wasted in overcoming the surface friction of the propeller blades in the water. If that were so, then the remaining blades must continue to offer the same proportionate frictional resistance; and of the 4400-horse power actually exerted by the engines of the ship on her last run, nearly 2000 would be wasted, and only 2400-horse power net would be left for other resistances and for propulsion, which is absurd. In the runs when the speeds were nearly identical, the thrusts must also have been nearly identical. The efficiency of both the four-bladed and the two-bladed screws was therefore so far the same. The defect of the former lay in the fact that much more power was required to turn them than sufficed with the latter. It may be argued, perhaps, that this statement is not accurate, and that the four-bladed screws really exerted a much greater thrust than their fellows, but that they operated in some unexplained way to prevent the influx of water to the ship's stern, and so increased her resistance. We see no ground whatever for this theory. The only feasible explanation of the phenomena appears to us to be that which we have already stated—the screws were harder to turn round with four blades than with two blades. Why they were harder to turn is quite another point, which we are unable to determine with certainty, nor are we aware that

any one else is in a better position. The problem deserves the most careful investigation, and we have no doubt it will receive it from Mr. Froude. But it is clear that the abnormal resistance did not materially affect the performance of the screw as an agent for giving a thrust. Yet if so much of the power had been wasted in what is known as "churning" the water, it seems probable that the thrust would have been diminished. On further examination we believe it will be found that the four-bladed screw was hard to turn, because it carried round with it a great deal of water. In other words, as it progressed ahead it continually imparted a motion of rotation to successive bodies of water previously at rest or moving in easy curves or right lines. The two-bladed screw does not do this to the same extent, because it is deficient in what may be termed transverse or projected area. In other words, the power of the engines was wasted in putting water in motion in a direction not parallel with the keel, and this motion was useless as a means of producing thrust. —*Engineer.*

## DOUBLE RUDDER AND MOVABLE PROPELLER STEAMSHIP.

By CAPTAIN SADLER.*

ABOUT the year 1848 Captain Carpenter, R.N., invented and built a steamer with two rudders. His idea was to increase the strength of steamers about the sternpost, shaft, and stern-tube, which is well known to be the weakest part of all screw steamships. He made a very wide sternpost, or two sternposts, wide enough apart to admit the shaft between the two. The rudders were placed forward of the propellers, and hung on the deadwood of the ship, close in before the sternposts, one on each side, similar to those of the model here on the table. He was painfully disappointed when on the trial trip he found that it would not steer. When the rudder was opened out to steer, the water rushed in behind it and upon the deadwood of the ship, and caused a perfect block to steering. This goes to prove that in order to secure perfect steering to a ship it is necessary that the water should pass with equal velocity on both sides of the rudder, and that the velocity must be equal to the speed of the ship. I will now give a brief description of the model, and will afterward point out some of the advantages such a ship would have over the steamships now in use. The rudders are hinged on the rudder-posts in the usual way, with gudgeons and pintles. The plates outside of the ship as far down as the rudders, also the plates inside the shaft-trunk, terminate at the rudder-post, and both are riveted through the rudder-posts, leaving no plates behind the rudders. One or two bars of flat or angle iron can be extended to the sternposts to support the rudder against the outside action of the sea, and for the rudders to rest against while in midships. Only one rudder is in use at a time, it being brought to midships before the other is opened out. Many apparatus may be contrived to steer with two rudders equally as simply as with one, either by hand or steam. Two of these I will illustrate by the model and drawings. The after end of the keel is wide (4, 5, or 6 feet, according to the size of the ship), narrowed into its usual width at about 50 feet forward. Through the keel are elongated holes, to allow the water to pass up into the shaft-trunk; and as the ship moves ahead, solid water comes up through these openings, and goes out between the sternposts and rudders, thereby securing perfect steering to the ship, and at the same time supplying unbroken water to the propeller. I have had my model in the canal several times with a powerful engine in her. She goes very fast, steers well, and leaves no disturbed water behind her. The propeller is raised and lowered by two vertical screws from the deck resting on the keel, and through the after-carrying bearing block. The journal bearing block oscillates in this carrying bearing block. On each sternpost inside is a slot about 3 inches wide and 2 deep, for the carrying block to work up and down in. These vertical screws can be worked by steam or hand as required. The after bulkhead is behind the universal joint with sliding-door (watertight), and upon the shaft is an oscillating ball, moving in a socket attached to the door. Of course the universal joint is completely boxed in and kept watertight, a manhole communicating with it from the deck for convenience of examination. The engines can be placed low down at the bottom of the ship, leaving only sufficient space for the cranks to work above the floor frames. This admits of the reduction of the angle of the shaft at the universal joint, when the ship is at sea, so that there would be very little, if any, friction upon the universal joint-pins. Indeed, I know no reason why the whole engine should not be planted in a leaning direction toward the stern of the ship, in which case there would be no angle in the shaft when the engines were going full speed. The heeling error in the compass of steamships is the cause of a very large proportion of wrecks and loss of life. Steamers are at the present time built on the narrowest margin of stability, and when loaded with light cargoes or grain, they frequently come into port with 15 or 20° list. The coal bunkers are in the middle of the ship, and generally at the broadest part, and when getting toward the end of a voyage there is about 30 or 40 feet of empty space amidships. I need hardly say that, in such circumstances, and when loaded, there is a tremendous strain upon the ship in that place, which never fails to show itself by the opening of butts on the outside of the vessel. Now in my improved steamships there would be no thwartship bunkers, the extra beam allowing sufficient room for all the coals in the side bunkers opposite the engine and boilers. In this case, toward the end of a voyage, when the coals in the side bunkers get diminished, there would still be the weight of the engines and the boilers, to resist the upward pressure of the water, and insure the safety and durability of the ship. All large steamers at the present time must be deep, in order to give diameter to the propeller and secure its immersion. It is well known that a deep, broad ship will not steam very fast, and if she is to be a good carrying ship she must be long, and the length of the ship weakens her. My propeller goes about 10 feet further down than those of the present class of steamers. If 5 feet were taken off the depth of the ship, my propeller would still be 5 feet lower than has hitherto been attainable, and would do its work far better than the propeller now does. It is important, also, to observe that, by allowing greater breadth of beam, it would lead to the strengthening and improvement of the vessel in every respect, and enable her to wear ten or eleven years longer without repairs. Permit me now to put in a concise form the advantages of this invention. Steamers built with these improvements will admit of much more beam, and several feet less draught of water, than those constructed on the stationary propeller and single rudder plan; thus shallows, bars, and rivers which are not navigable to the large steamers of which the merchant marine service now consists, and harbors, similar to that at New Orleans and other places, impracticable to such steamers from the great draught of water necessary to secure the immersion of the propeller, will be practicable to steamers having equal, if not greater, carrying capacity, constructed with the improvements referred to. These improved steamships will possess greater strength and be safer and better sea boats than the steamers now in use, because of the superior proportions of construction which the improvements referred to admit of. The carrying capacity will be increased without a proportionate increase in the cost of construction. There will be no vibration and no racing of the engines at sea, and, therefore, the greatest possible immunity from those accidents arising from convulsions which are common to ocean steamers now afloat; security against listing, shifting cargo, and consequently against the "heeling error" in compasses, while the economy of motive power by providing against "slip" will be very considerable. Further, the density of water increasing in the ratio of depth, the motive power for steamers of say 325 feet in length with 50 feet beam, and drawing, when loaded, 18 or 19 feet water, and constructed on this improved principle, would be more directly and economically applied than on steamers of the proportions of which the first-class steamers of the merchant service now consist, encountering as they do, from their great draught of water, a powerful resistance in the increased density of the water, besides losing, even in moderate weather, sometimes as much as 30 per cent. of their motive power in "slip" by pitching. In case of any accident occurring to the machinery at sea, rendering steam as a motive power impracticable, the propeller can be raised out of the water, and steamers with these improvements could therefore proceed much more advantageously under sail than steamers without such improvements. It may be noted that this arrangement would be particularly advantageous in the case of steam yachts. They seldom have a propeller with more than two blades, and it could be hove up right under the stern, completely out of the water, to allow the yacht to proceed under sail. In the case, too, of steamers going on long voyages, such as to Australia, when caught in a fair wind they could stop the engines, put out the fires, and go even faster under sail than with steam, with a saving in each trip of from £400 to £500 in the account for fuel. I believe that of late years considerable attention has been given by naval constructors to getting the propeller placed lower down into the water of men-of-war, gunboats, and torpedo-boats, to keep shot from striking it; and I know of no better arrangement for effecting such a purpose than that which I have been endeavoring to describe. And it will readily occur to any one whose attention is directed to the subject, that the improvements under notice would secure similar advantages for war vessels, as regards strength, speed, etc., as in the case of our mercantile ships.

Further, all necessary repairs connected with the propeller can be made either at sea or in port without docking, while, by virtue of these improvements, steamers would be constructed so as to admit of being shifted without ballast, and even of crossing the Atlantic with little or no cargo, excepting coals for the voyage out and home. Protection from certain sea damages to which other steamers are exposed being secured to steamers possessing the improvements referred to, such as losing propellers, breaking shafts, carrying away rudders, sternposts, etc., insurance risks would be reduced, and insurance companies would accept risks on such steamers and on their cargoes on more reasonable terms. In addition to these and other advantages accruing to the merchant steamer service from the improvements referred to, steamers constructed with said improvements will be vastly superior as passenger ships, inasmuch as the vibration, rolling, listing, and other discomforts which are now experienced in Transatlantic and similar voyages will be reduced to a minimum, and the greatest possible comfort secured.

In the after discussion, and in answer to questions—

Captain Sadler explained how the screw propeller of his model was attached to the shaft, and the differences between his apparatus and that of Messrs. Harland & Wolffe, remarking that his had no connection with the keel.

Mr. A. Brown thought Messrs. Harland & Wolffe's apparatus had quite as good an attachment as Captain Sadler's.

Mr. R. Duncan inquired if Captain Sadler had calculated the probable increased cost of building a vessel with his arrangement of double sternposts.

Captain Sadler answered that he thought it would not be very different from what it was at present, as everything was very simple. But he had not gone into that question.

Mr. Duncan said that the after part of the keel of Messrs. Harland & Wolffe's steamship *Britannic* had cost something like 2s. 6d. per lb. to make. The whole stern frame of the *Britannic* cost about £10,000. Captain Sadler's arrangement would be quite as costly.

Captain Sadler replied that with his arrangement the vessel could carry a greater quantity of cargo, which he was satisfied would repay shipowners for any extra first cost.

Mr. A. C. Kirk said that in some special cases this arrangement might be worth adopting, but in common merchant ships he thought it would not be found useful.

Mr. J. Howden said he should fancy that it would be scarcely possible for the water to pass up through the hollow spaces shown in the model sufficiently fast to prevent a considerable negative pressure behind the broad stern part.

* Read before the Institution of Engineers and Shipbuilders in Scotland, February 19th, 1878.

## THE SOCIETY OF TELEGRAPH ENGINEERS.

*De La Rue's Chloride of Silver Cell.*—Dr. Muirhead's paper on this subject was read by Mr. Latimer Clark, M.I.C.E., past-president of the Society, and the chairman for the evening. The principal object of the paper was to point out the fact, observed by Dr. Muirhead, that this cell is remarkably well suited as a testing battery and as a standard of electromotive force. This is due to the unusual constancy of its electro-motive force from day to day and from month to month, to its uniform resistance, and its small and portable form. The cell is made by taking a cylindrical rod of pure zinc about the thickness of an ordinary penholder for the negative pole, and a similar rod of chloride of silver, moulded by heat into the required cylindrical form, for the positive pole. These two poles are then immersed in a small tubular glass vessel containing pure chloride of ammonium. The positive pole, or chloride of silver, is sometimes inclosed in an enveloping cylinder of parchment paper, which acts as a porous diaphragm.

The whole cell is about four inches in height and one inch in diameter. To prevent evaporation of the liquid a stopper of paraffine or of cork is fitted to the mouth, holes being perforated in it to allow the electrodes of the cell to pass through. The electrodes are of silver wire or silver strip, the negative one being soldered to the zinc, and the positive one being cast into the silver chloride. The electro-motive force of such a cell is about 1·16 volt, and its resistance is about 5 ohms. Its great merit consists in the fact that although in daily use for months, it preserves its electro-motive force and resistance practically the same. It is therefore very advantageous in the testing of submarine cables, since the variations of electro-motive force in the ordinary Minotto testing battery frequently cause irregular movements of the needle of the galvanometer very troublesome to the observer, and prejudicial to the accuracy of the tests. With the chloride of silver cell this disturbing element does not appear, and the proper motions of the needle can be observed with accuracy. The small and portable form into which this battery can be made up—50 cells occupying about a cubic foot—is another point in its favor for electrical testing at sea or in the field, and it is likely to become a favorite battery for this purpose. The first cost of manufacture is in excess of the ordinary cells owing to the expense of chloride of silver, but pure silver is reduced in the action of the cell, and as this can either be sold at a price realizing 80 or 90 per cent. of the original cost of the chloride, or can again be turned into chloride by the addition of a little hydrochloric acid, the cell is in the end an economical one.

Mr. Clark justly observed that we had a sufficient standard of resistance in the British Association unit, and a sufficient standard of capacity in the micro-farad condenser; but we had not been so successful in getting a reliable and constant standard of electro-motive force. It was with this view that he had constructed in 1873 the small mercury cell known as Clark's standard element. This element is composed of the metals zinc and mercury, separated by a paste made by boiling mercury sulphate in a concentrated solution of sulphate of zinc until the air is expelled. All the materials must be of the purest kind, and a little free mercury may be added to the paste with advantage. The cell is about 2 ins. high and 1¼ in. in diameter. Zinc is the negative pole, and the electro-motive force is 1·456 volt. This cell was only designed as a standard of electro-motive force, and was not intended to give a current. Its internal resistance was not, therefore, considered. It has, however, been used in the ordinary way, but it quickly polarizes. A defect has been found in the drying up of the paste, and consequent failure of the cell. Steps have been taken, Mr. Clark said, to remedy this weak point by excluding the air from the semi-fluid paste. It is a question yet to be decided whether or not the chloride of silver cell is better than the Clark's standard element as a standard of electro-motive force; and Mr. Clark stated that he intended, in conjunction with Dr. Muirhead, to make an absolute determination of the electro-motive forces of both. Should the chloride cell prove as constant as the other, it will be the more advantageous, since it can be more readily set up, and the electro-motive force is about a volt.

*Burns' Pneumatic Battery.*—This remarkable battery is a peculiar form of the ordinary bichromate of potash cell. The negative pole is a zinc plate; but the positive pole, instead of being a carbon plate, is, in this form, a compound metallic plate, formed by coating a copper plate with lead and facing one side with a plate of platinum. A section across such a plate would therefore pass through lead, copper, lead and platinum in succession. The backing of copper to the platinum plate diminishes the resistance of the positive pole, while the lead protects the copper and solder from the acid solution. This is made by adding 12 ozs. of bichromate of potash and 1 pint of sulphuric acid to 5 pints of water. The peculiarity of the cell, however, consists in an arrangement by which air can be pumped into the liquid. This is effected by having a perforated tube running along the bottom of each cell, and a hand syringe or bellows in connection with it, so that air forced into the tube escapes through the perforations into the liquid. This circulation of air gives rise to an extraordinary strength of current in the circuit of the cell and to an equally extraordinary development of heat within the cell. Ten of the cells exhibited heated a stout platinum wire, 30 ins. long and No. 14 B.W.G., to a glowing heat on pumping. The heating took place gradually as the pumping went on, and the wire cooled again to its dark state when pumping was left off. Some idea will be formed of the great heating power here displayed, when it is remembered that it takes 70 or 80 Groves elements to heat a similar length of No. 18 or 24 B.W.G. platinum wire. The battery was, in consequence of its heating effect, introduced by Dr. Burns for the actual cautery, and an important operation has recently been successfully performed in London by its means. The same 10-cell battery even yielded a small but beautifully brilliant electric light with two carbon points. The electro-motive force of each cell is about 1·7 volt, and the internal resistance, according to Mr. Preece, is by the ordinary instruments immeasurably small.

Why the pumping of air into the cell should increase its current strength so much is a problem not yet decided. In order to determine whether it was due to some chemical action of the air, or to its merely mechanical action, Mr. Ladd pumped air, oxygen, and hydrogen, one after another, into the cell, but no difference was observable in the action of the cell. It was all the same which gas was pumped in; and hence he concluded that the effect was due to a mechanical cause. Since either an increase of electro-motive force or a diminution of resistance will produce an increase of current strength, Mr. Preece measured its electro-motive when quiescent and also on pumping; but no difference could be detected. He then attempted to treat its resistance in the same way, but failed to obtain a measure of it by ordinary means, it being so small. It was the opinion of Dr. Burns that the effect was due to a depolarizing influence of the air on the plates of the cell, but Mr. Preece's experiments veto that explanation. A notable point about the cell is the high temperature developed in it by the pumping; it being impossible, after a time, to handle the cell because of its hotness. The explanation offered by Mr. Preece is that this heating of the cell reduces its internal resistance; but may it not rather be that the heating itself is due to the abnormal chemical action going on in the cell and necessary to produce the powerful current?

Professor Adams suggested that it might be due to a circulation of the liquid, promoted by the air, so that fresh acid came into contact with the zinc plate. This would have the double effect of increasing the chemical action and diminishing the resistance. Mr. Preece argued against this explanation that if it were due to fresh acid it would be an instantaneous effect, whereas we had seen the heating of the platinum wire, *i.e.*, the rise of current strength, to keep pace with the pumping.

Mr. Ladd was inclined to attribute the effect principally to the positive pole of the cell and the diminished resistance it offered; and Mr. H. Edmunds, Jr. (who exhibited the battery on behalf of Dr. Burns), said that Dr. Burns also re-

ferred a great deal of the efficacy of the cell to the positive pole. He mentioned that Dr. Burns had also obtained remarkable results by using dilute sulphuric acid as the exciting solution, and dispensing with an air pump, but retaining the compound plate.

*Barlow's Logograph.*—The "logograph" of Mr. W. H. Barlow, F.R.S., M.I.C.E., is an instrument for giving a graphic representation of the vibratory motions of the air waves of speech. It was invented four years ago in order, if possible, to become a means of short-hand writing; this, however, it has not yet succeeded in becoming. It depends for its action on the well-known fact that in speaking the air is forcibly expelled from the mouth in jets of different intensity and magnitude. It consists in a mouthpiece similar to that of a speaking trumpet, which is inclosed at one end by a thin India-rubber diaphragm about 2¼ ins. in diameter. A small camel-hair pencil moistened with ink or aniline dye is attached to the center of the diaphragm so as to partake of its motions. A strip of white paper is caused to move uniformly past the point of the pencil-marker by clockwork. On speaking into the mouthpiece the diaphragm is violently agitated, and the hair pencil draws a fine irregular line along the paper strip. This line is a delineation of the mechanical air motions produced by speech. The same words always give almost exactly the same representation. There are minor variations due to some cause or other, but the larger features of the curve are conspicuously the same, and it would be possible by a comparison of a number of results to obtain typical curves which would be a correct graphical representation of spoken language. The consonants give long pointed curves or deviations from the zero line, whereas the vowel sounds give minute vibrations or ripples. These ripples are due, Mr. Barlow thinks, to the drone of the voice accompanying the vowel sound. The resemblance of the logograph writing to the telegraphic message from a siphon recorder is very apparent.

Mr. Barlow also gave a few interesting statistics which he had gathered from experiment. From these it appears that 1½ cubic in. of breath are ordinarily exhaled in uttering each vowel sound. In an ordinary expiration there are 40 cubic inches of breath, and 80 or 90 cubic inches in an extraordinary one.—*Engineering.*

## THE KITTATINNY BLACKBERRY.

By E. WILLIAMS, Montclair, N. J.

THE Kittatinny blackberry patch you inquire about, the sight of which so impressed you and others, is among the things that were—not for any fault of its own, but owing to the march of improvement, the value of the land, the low price of the fruit, and the voluntary aid in gathering it, which we could not prevent without being constantly on the watch, and we did not feel inclined to grow berries for the public gratis, and depend on the fruit they left for our own use. I assure you, however, there was no "hocus-pocus" or secret manipulations attending the inception or management of that little patch. The soil was very thin, the poorest of any on our place, and underlaid with a very poor clay sub-soil—a very unpromising spot we thought and still think. It had been in corn the year previous and was the only available ground we thought we could spare for the purpose. It was plowed, harrowed, and furrowed in rows about seven feet apart. The plants, grown from root-cuttings, were taken in one hand, the other being free to take one plant at a time, and walking along the row placing one about every four feet, and with the feet hauling some dirt on the roots to cover and hold it in place. This being done we hauled on fresh barnyard manure, putting a forkful between every two plants. This was then spread along the rows and covered. They were cultivated during the season and allowed to grow at will. Root-cutting plants are the best in this particular—that more roots radiate from a given center with more fibrous roots. Sucker-plants generally consist of a single root or nearly so. The second season the plants were pruned pretty close, the main cane one and a half to two feet, and laterals four to six inches. Posts were set at each end of the rows and braced, and a single wire stretched from one to the other about 3½ feet from the ground, with stakes driven about thirty feet apart, intermediate, for additional support.

One or two canes only were allowed to grow this second season, and these, as they reached four feet in height, were pinched off and tied to the wires. If pinched at this height the canes will lengthen to about five feet before hardening. The fruit the second season after planting is generally so indifferent, unless the plants are very strong, that it would be better to cut the plant entirely off, so as to throw the entire strength of the plant into the canes of this season's growth. Blackberries and raspberries are perennial-biennials—*i. e.*, the cane that grows this year bears fruit next year, then dies. In the spring of the third season the canes were loosened and tied at an angle of about 30°, right and left, thus making room for the young canes to come up straight as before, and not interfere with the bearing canes. The string in either case should be twisted around the wire, so as not to slip and chafe the cane. The annual pruning consisted in cutting out the old canes either in Autumn, after they had done fruiting, or the following spring (as they are then dead), and the shortening-in of the branches of the new canes to about eighteen inches at the base to six at the top. The pinching process checks growth, develops the buds on the cane, and causes it to throw out branches nearer the base, making it strong and stocky, while, if allowed to grow unchecked, they sometimes attain a length of eight to ten feet, with the lowest branches two to three feet from the ground, and are troublesome and difficult to manage, the wind having much greater leverage power on such long canes. When once established, but two canes were allowed to grow each year, all others being cut away. This gave strong, vigorous canes that had the ability to bear a heavy crop of large fruit. We never could produce satisfactory crops of any kind on such weak and puny canes as we have seen in some sections where all the canes were allowed to grow. The after treatment consisted in cultivating to keep down the weeds, treating all plants that came up outside the rows as weeds, manuring as needed, and mulching to save the labor of cultivating. There was just one-third of an acre in the "patch," and one season we kept a record of the sales, which footed up thirty-three bushels, which, according to our arithmetic, is nearly at the rate of 100 bushels per acre. The amount consumed by visitors, birds, bees and wasps was not taken into account, and I assure you it was no small quantity. The prices realized were generally fifteen to twenty-five cents per quart. One year, following a very severe winter which destroyed the crop generally throughout the State, we realized 40 cents per quart. We have no doubt we could achieve equal success in another attempt, neither do we doubt the ability of any one else to succeed as well as we did and could. In making another effort we should put the rows eight feet apart, at least, and endeavor to mulch to avoid cultivating as much as possible, as the branches of the canes are so friendly that many are torn off by catching your clothing, the harness and tail of the horse as he switches it to keep off the flies. The fungus known as "yellow rust," so destructive to the Kittatinny in some sections, has injured us but little. It, like the pear blight, seems to be epidemic, and the only remedy recommended for this and kindred diseases is to cut off, or dig up, and burn the plants affected. It does not accord with my usual custom to extol the Kittatinny or anything else I have been chiefly instrumental in disseminating. Testimony from such sources is generally regarded as *ex parte*, and I regret to say it is too often the case. We always prefer the testimony of others in cases of this kind. The present standing of the Kittatinny in this State is indicated by the vote of the State Horticultural Society, last year, as follows:

Kittatinny, for market, 17 votes; for family use, 19 votes.

Wilson's Early, for market, 15 votes; for family use, 11 votes.

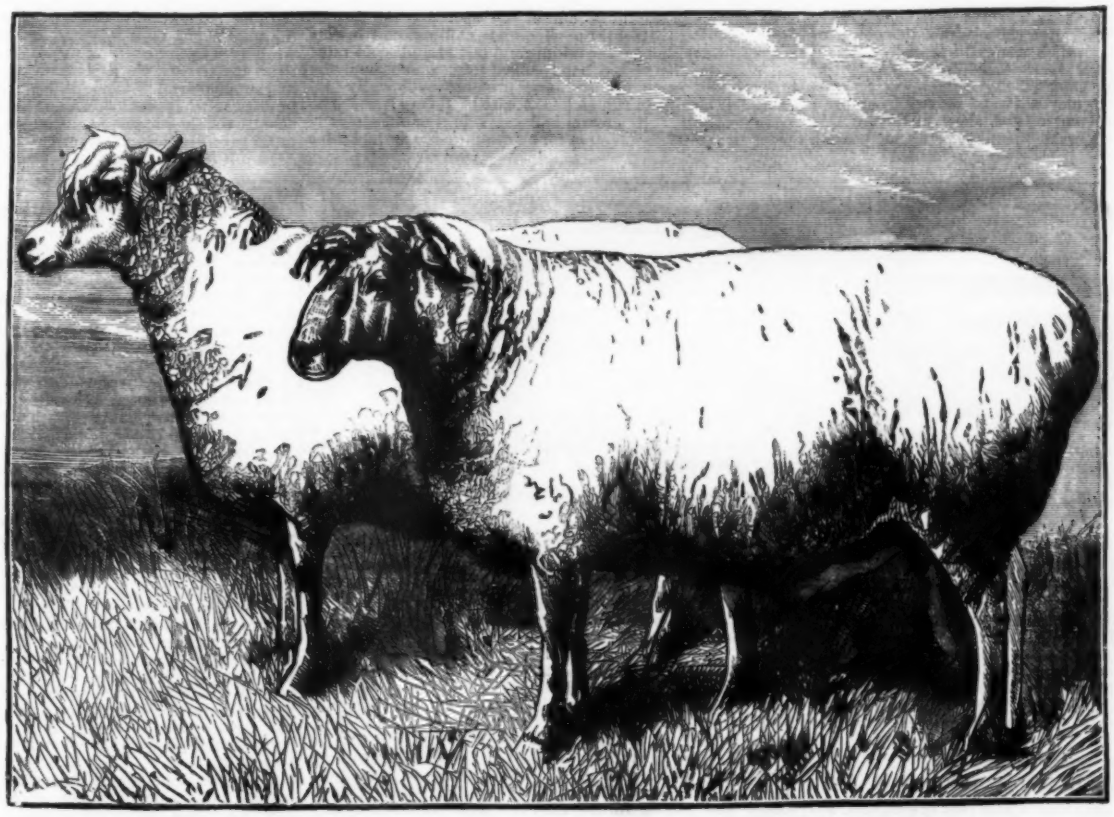
New Rochelle, for market, 6 votes; for family use, 6 votes.

Dorchester, for market, 3 votes; for family use, 3 votes.

The Wilson, which is so popular and does so well in the lighter soils of Southern New Jersey, is worthless here. In the last report of the American Pomological Society, "the State or district in which a fruit is recommended for cultivation is designated by a star; if the variety is of great superiority and value, by two stars." In this report the Kittatinny has one star for fifteen States, and two stars for nine States. Wilson's Early has one star for nineteen States, and two stars for four States. The Kittatinny is sometimes injured in winter in some sections, but I think this injury is due more to the condition in which it goes into winter quarters than to the severity of the winter, for I have seen full as much if not more injury after a mild winter than after a severe one. I think injury is more likely to result from such sudden changes as we are now experiencing than from a steady severe winter. This morning (March 25) the mercury marked a temperature of 10°, a change of about 60° in less than forty-eight hours. The chief objection we ever discovered was its thorns, and this will apply to other varieties as well. Could we produce it without these, we should have about as perfect a blackberry in all its parts as it is possible to expect, and its culture for field or garden would be attended with much more pleasure and satisfaction. I trust the foregoing is sufficiently explicit to cover the points of your inquiry.—*N. Y. Tribune.*

## COTSWOLD SHEEP.

THE antiquity of the Cotswold is established beyond contradiction, and there is little doubt that the original Cotswold sheep were, if not the earliest, at any rate one of the



THE COTSWOLD BREED OF SHEEP.

earliest breeds in Great Britain. These sheep are natives of the Cotswold, or Cotteswolde, Hills, which run through the eastern side of Gloucestershire, in a direction from southwest to northeast. The name is derived from the cots or sheds in which, in early times, they were housed at night, or permanently in the winter, and from the wolds, or open, hilly grounds, on which they were pastured in the summer. In the early days the Cotswold sheep were valued principally for their wool; they were large-framed, coarse, slow-feeding sheep, very hardy and accustomed to much travel in search of the short, sweet herbage which invariably prevails on limestone hills.

There can be no doubt that the Cotswolds have been materially improved by an infusion of the Leicester blood in the same way as the other long-wooled breeds. To this may be attributed, to some extent, the great aptitude for feeding which now characterizes this breed, while the Cotswold sheep of the present day are remarkable for symmetry, early maturity, and weight. The feeding qualities of the Cotswolds were subjected to careful experiments by Mr. Lawes at Rothamstead, England, who found, in comparison with Downs, they consumed the least food to produce a given amount of increase, and made the greatest progress in a given time. The tendency of the Cotswold is to accumulate fat upon his back; the breast is not quite so wide or prominent as that of the Leicester, while the flesh is coarse and open. These sheep are still and quiet in their habits, and are considered by English breeders one of the best kinds for carrying out the board or hurdle feeding.

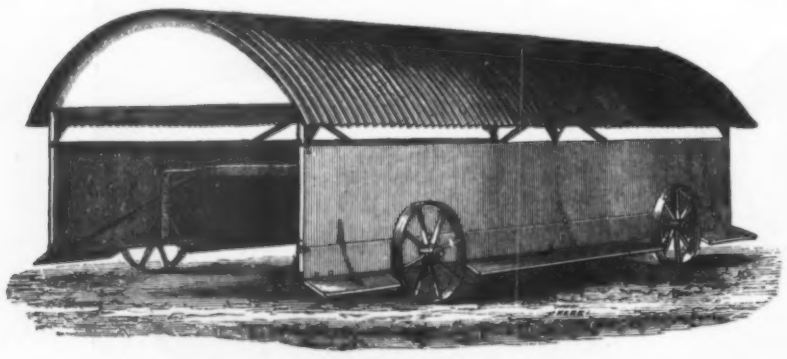
The Cotswolds are the largest breed of domesticated sheep in the world, and, standing rather high upon the legs and having very grand heads, they have a truly imposing appearance. The features are either white, gray, or mottled; the former predominates, but a little color in no way detracts from appearance or indicates impurity. They present a complete contrast to the Leicesters, and if they are indebted to them for early maturity and tendency to feed, they do not take after them in external form. The head is rather large,

wide across the forehead; the eyes full and prominent. It is considered a point of importance that the head should be well wooled, particularly the forehead and cranium, and that long locks hang down over the face; if the eyes and upper part of the nose are covered, so much the better. This description applies to shearling rams, yet in all, whether male or female, bare heads are an abomination. The effect of the love-locks is striking, adding immensely to style. Occasionally the profile is slightly Roman, but this is rather objectionable, as it gives a common character. The neck should be long and moderately thick, especially at the base and where it joins the head. The carcass is long, level along the back, and the ribs well sprung; the under lines are not so true, and the flank is often weak. The thighs are moderately full, the leg of mutton being much more developed than in the Leicester, and, though there is much external fat along the back, which gives a soft, springy touch, lean meat is also abundant. The wool should be long, open, and curly; the staple is coarser and the weight of fleece usually rather less than the Leicester and the Lincoln.

Cotswold sheep were introduced into the United States about forty-six years ago, although the first considerable importation was not made until 1840, and then by New York parties, but now this country boasts of some very fine flocks of recent importation from England. An American Cotswold Association is organized, and the Cotswold record is reported as progressing favorably. The thoroughbreds are held in high esteem for crossing with common ewes, for the raising of early lambs for the butcher, or for producing choice mutton and good combing wool. Since such wool now commands the highest price, and the mutton trade, both for home consumption and exportation, is rapidly increasing, it is safe to predict that the Cotswold sheep is destined to grow rapidly in favor among farmers of the Eastern or Middle States, or wherever sheep are reared for remunerative returns, in both wool and mutton.—*Boston Cultivator.*

## MOVABLE SHEEP SHELTER.

THE accompanying illustration shows a movable cover for sheep, invented by an English agricultural writer, Mr. J. Buchanan, and given in the *Agricultural Gazette*. As will be seen, this furnishes a convenient shelter, which, owing to its lightness of construction, may easily be moved from place to place. The roof is of corrugated sheet metal, suitably braced; the wheels are of broad tread, to admit of passing



MOVABLE SHEEP SHED.

over soft ground, and the cross braces are carried at a sufficient height to be out of the way. Economy suggests proper attention to the comfort of stock of all kinds, and those who are most observant of details of this description are, as a rule, the most successful raisers. Especially in the case of thoroughbred stock is this the rule. The essential requisite of cleanliness is secured by changing the quarters whenever it becomes desirable.

## POISON FOR RED SPIDER.

I FIND from experiments this winter that sulphureted hydrogen gas is an easy and effectual means of destroying the red spider without injury to the most delicate plants. All other insects are destroyed at the same time, and I think mildew is arrested, but am not sure on this point. My plan is to take a water-tight vessel, such as a keg, that will hold the plant and leave room on the bottom for a teacup. After placing the infested plant in the keg I put by the side of it the teacup, about half full of dilute sulphuric acid—about 1 part of acid to 5 or 6 of water. I then wind the end of a fine copper wire two or three feet long around a piece of sulphuret of iron as large as a lady's thimble, so as to hold it securely, and, using the wire as a handle, let it down into the cup, and cover all up tightly with a bundle of papers pressed down by a bit of board. After ten or fifteen minutes the cover is raised a little and the iron sulphuret drawn out by means of the wire. The plant is allowed to remain about a half hour longer. A little strong ammonia will neutralize the odor of the gas, which, however, if the operation is skillfully performed, does not escape in sufficient quantity to make it worth while to neutralize it. The remedy is so obvious to any one familiar with the properties of the gas that I think it must have been tried before, but I have never heard that it was.—R. K., *in Country Gentleman.*

## MANAGEMENT OF TURKEYS.

YOUNG turkeys commence to chip the shell on the twenty-sixth day after setting; oftentimes, if the weather be very warm, a day or twenty-four hours sooner. The natural mother is always the best for the rearing of the young. The hen turkey usually commences to drop her eggs in April; in some cases the last of March, if the season be forward, or if the preceding winter was open, but it is not desirable. From sixteen to eighteen eggs is the common clutch for a hen to drop before commencing to sit, but young turkeys will lay in some instances from forty to sixty eggs before offering to sit. More frequently they do not sit the first season where well kept. In this case other fowls must be employed to incubate the eggs. Common hens are not very suitable to rear turkeys, yet necessity compels us sometimes to employ them. In the first place, the usual period of incubation for hens is from eighteen to twenty days—perhaps a day longer when not a good sitter. This is one drawback, and anything but a Brahma becomes discouraged before the time is up, and either quits the nest or becomes unsteady in her habits. A common hen is not fit to run with turkeys, as their natures are rather slow and sluggish; and although pretty early risers, yet turkeys do not commence their rambles until the sun is well up and the night dew has gone from the grass and the chill from the air, when they are allowed to indulge in their natural habits. They are moderate movers, and will each day ramble off perhaps a mile or more from home, and yet will not become so much fatigued at night as those allowed to run with a common hen. This latter mother is too quick and fussy in her movements to suit the turkey.

The turkey hen is steady and quiet, and seldom alarms her brood without cause, and, as a general thing, is exceedingly fond of her young, which she never weans. I have seen her sitting on her second clutch of eggs with her first brood all around her. There appears to be a perfect understanding between her and her offspring. They will wander off a short distance to search for insects, but at the least alarm seek the refuge of the mother wing. Their habits thus render them liable to the machinations of foxes and weasels, and they often fall the prey of these destructive animals, a whole brood, together with the mother, being sometimes captured in one night. When they meet with no disturbance, day by day, the older brood will wander off by themselves, or frequently join the other flock, until they have forsaken the mother nest, which they will do before the late brood comes off. Thus there is no difficulty. Their acute instinct teaches them to avoid this, and yet no harsh measures are resorted to. Turkeys are remarkably clean birds, much more so than dunghill fowls, and are seldom infested with vermin. The presence of vermin on their bodies is far more destructive of young poultry than many are aware of. Some observant poultrymen pretend to say that it is the sole cause of the gapes. This fact cannot have full indorsement. No doubt the disease is greatly aggravated, but instances are known where the chicks were much troubled with lice, and yet never had so much as a touch of the gapes.

Every turkey should be out of the shell by the first of June. Earlier than this the winds are chilling, and insects are not plenty, but by the middle and last of June cold rains are all over, the season has changed into summer, and the turkeys that came off by June first are sufficiently advanced to be able to run and take care of themselves. The grain fields are fully grown, and grass in the meadows is deep, and affords protection for the young; the hedges offer shelter from showers and sudden rains. In a few weeks the young birds become fully feathered, and will be fit for market by Thanksgiving. For the first three or four weeks the chicks should be kept pretty snug about home, and should not be allowed to run at all the three or four days immediately after hatching. Give strong, nutritious food, which should be a custard made stiff and rich with eggs and milk for the first feeding, boiled eggs and scalded meal afterward for the first week, then gradually introduce buckwheat, until by the last of the second week it becomes the principal food, giving the birds their liberty a little longer and a little further each day until three weeks old, when their backs will be covered with feathers, and the greatest danger over. Train them at first in the ways they are to run, and teach them to come home at night for their feed.—*Country Gentleman.*

## SUBTERRANEAN FORESTS AND MESQUITE THICKETS.

THE authors of the book named "Two Thousand Miles in Texas on Horseback" tell a wonderful story about the subterranean forests which they observed on the prairies lying near the River Concho, in the western part of the State. "Riding over these vast prairies," thus their story runs, "though you will see no trees, yet you will often see a tender little switch of the mesquite shooting a few feet above the ground. Now, stop at one of these, and strike at its root with a pickax—you will expect nothing but tender, fibrous roots; but, instead of these, the pick comes in contact with a heavy, solid body. Surprised, you remove the thin covering of earth and find a living log as thick as a men's leg extending you know not how far. Exploring further around the same little shoot, you find many logs of the same size, and an infinite number of branches extending from them. Thus each little twig yields you from a quarter to a half cord of fuel-wood not equaled for that purpose by any other wood within my knowledge. Thus these treeless plains are filled with fuel almost equal in its supply to the heaviest forests. These shoots do not increase in size, but, after attaining a certain dimension, too small to be dreaded by an urchin, they either stand at that or die and give place to others. The branches of the large roots left in the ground speedily supply the loss by other roots as large as those taken away."

Various theories are put forward to account for the existence of these underground forests, but none cited by the narrators of the story are satisfactory. It is said by some that the burning heat of the sun has prevented the growth of the trees above ground. Others urge that the scarcity of rain in the region has induced the phenomenon; and, again, that it is owing to the frequency of the prairie-fires, which consume the vegetation exposed to its effects. But the same influences have nowhere else produced the same remarkable results.

The mesquite (*Prosopis dulcis* or *Algarabia glandulosa*) of Texas is a thorny and gnarled tree of the order Leguminoseæ, and sub-order Mimoseæ. It yields a gum which is a good substitute for gum-arabic, and is known in commerce as mesquite gum. Its bark and wood are rich in tannic acid, and are excellent materials for tanning hides. The tree spreads rapidly, and when not kept down by fires soon covers the prairies with a thick growth, called "mesquite chaparral."

"The growth of this chaparral, or thicket," say the writers already quoted, "is a brush, shooting out a number of long branches, from a common center at the ground, armed with thorns, and every branch produces a number of smaller branches likewise armed. The foliage is light and feathery, pinnate, and drooping in long racemes. Such is its character here and in all chaparrals; but when it grows alone, or scattered widely apart, it becomes a tree, about the ordinary size of the peach, and at a distance, when stripped of its leaves in winter, greatly resembles that tree. In the chaparral it is almost an evergreen, for its long-reaching multitudinous boughs protect from the cold northers, and seem to maintain perpetual spring. . . . . It yields annually an abundant crop of beans—the pods, from five inches to a foot in length, hanging in clusters from the boughs. These pods are very similar in appearance to that of the corn-field pea; but, owing to a rich saccharine pulp, they never become shelly or dry. They cannot advance to a higher state of desiccation than the sugar-corn, either in the pod or bean. The bean is small and flattened, separated from each other by a considerable space of pulp in the pod, and, when chewed in the mouth, is sweet to the taste and sticky to the teeth. When ripe, horses and cattle devour them with great relish, and they will not touch them when not ripe, because they are then bitter and acrid. It can hardly be doubted that in nutritive matter they excel any edible food in existence, and milkmaids say they produce a greater and richer flow of milk than any food they are acquainted with."

Although a mesquite thicket seems to be impenetrable, with its interlacing boughs armed with thorns, the stems of the trees stand some feet apart, affording open spaces and winding ways, through which horses and cattle can easily roam and feed on the nourishing mesquite grass that grows in the chaparral. The skilled horseman of the Texas prairies, clad in buckskin and heavy gloves, is protected against the thorns, and can dash through the thickets at a rapid pace.—*Chicago Tribune.*

## THE TSETSE.

THE Scotch Presbyterians established, soon after the death of Dr. Livingstone, a mission on Lake Nyassa, in Central Africa, naming the station Livingstonia, in memory of the great explorer. It seems probable that this station will have to be abandoned on account of the ravages of the tsetse, a fly whose bite is fatal to domestic animals. It has been supposed by scientific men that the destructiveness of this insect was greatly exaggerated by travelers in Africa, but the experience of the party at Livingstonia bears out the testimony regarding it given by Livingstone, Cumming, Stanley, and others. A letter from Livingstonia, dated August 8, gives some particulars of the trouble encountered in regions where the tsetse abounds. The writer says: "I am sorry to say there can be no doubt regarding the suspected fly being really the tsetse. All the cattle I bought when down the Shire, in January, and which were brought up here, have died. This of itself would not have been sufficient proof, as we found that at times the tsetse were seen at Pimbi, and two cows died there; but any error arising from this cause was eliminated by the present of a fine bull from one of the lake chiefs. He, too, succumbed, showing all the symptoms usually following the tsetse bite. All our dogs have perished, mostly from the same cause. This is to us a sad calamity, the results of the presence of this insignificant looking insect being these: (*a*) no domestic animals which can be used as beasts of burden can live here; (*b*) industrial operations are seriously impeded, many quite obstructed; (*c*) our usefulness in advancing the civilization of Africa is so much curtailed; and (*d*) a new site for Livingstonia must be sought for."

It will be remembered that when Stanley set out on his famous expedition in search of Livingstone he took with him two horses, although warned by those used to African travel of the hopelessness of the attempt to get them alive through the tsetse districts. Stanley encountered the formidable insect on reaching the frontier of Ukwere, and his horses soon succumbed to its attacks. With characteristic energy he studied the habits of the tsetse, determined to prove beyond a doubt if it were as dangerous an enemy as had been represented. Three species of flies fell upon his caravan at once, and, to discover which was the dreaded tsetse, he procured specimens of each, and subjected them to a close examination. Swarming in his tent, the insects "kept up a continual chorus of sounds; one performed the basso profundo, another a tenor, and the third a weak contralto."

Of the three singers, or hummers, the contralto-voiced proved to be the true tsetse. "If this insect," says Stanley, "sang the feeblest note, it certainly did the most work and inflicted the most injury. Horses and donkeys streamed with blood and reared and kicked through the pain. So determined was it not to be driven before it obtained its fill that it was easily dispatched; but this dreadful enemy to cattle constantly increased in numbers. The three species above named are, according to natives, fatal to cattle; and this may, perhaps, be the reason why such a vast expanse of first-class pasture is without domestic catttle of any kind, a few goats only being kept by the villagers."

After the death of one of his horses Stanley had the stomach of the animal opened, and "there were found twenty-five short, thick, white worms, sticking like leeches into the coating of the stomach, while the intestines were almost alive with numbers of long white worms." These were the larvæ of the tsetse, which, with the bites of the perfect insect, wasted the life of the beast.

The tsetse, known to entomologists as *Glossina morsitans*, is thus described by Stanley: "Not much larger than a common house-fly, nearly of the same brown color as the honey bee. After-part of the body has yellow bars across it. It has a peculiar buzz, and its bite is death to the horse, ox, or dog. On man the bite has no effect, neither has it on wild animals. When allowed to feed on the hand, it inserts the middle prong of three portions into which the proboscis divides; it then draws the prong out a little way, and it assumes a crimson color, as the mandibles come into brisk operation; a slight itching irritation follows the bite."—*Chicago Tribune.*

[Translated by MADAME BLAVATSKY, F.T.S.]

## DEFINITE CONCLUSIONS OF SCIENCE.—OUR EARTH MOTIONLESS.

A popular lecture proving that our globe neither rotates upon its axis nor around the sun.—Delivered at Berlin by Dr. SHŒPFER.

GENTLEMEN:

ONE should be endowed with unlimited courage to dare come out before a large audience with proofs of the erroneousness of a scientific formula which since our earliest youth we had been taught to regard as the only correct and unerring theory. I am pretty certain that at this moment you have come to the same conclusion about me as, four months ago, I would have entertained myself of any man who should have asserted that it is not the earth which revolves around the sun, but the sun which revolves around the earth. I would have considered such a man either an ignoramus or a lunatic; nevertheless, I now consider the immobility of the earth an incontrovertible fact, and even hope that my convictions will be shared by those who without prejudice will reflect upon that which I will now impart to them.

Some time ago we had the opportunity of witnessing the series of experiments with a pendulum which, according to the theory of the celebrated physicist Léon Foucault, furnish proof of the diurnal rotation of the earth around its axis. I had long neglected to acquaint myself with these experiments, although, while explaining to my pupils the motion of the earth around the sun, I had always found very extraordinary results—absurd, I ought to say—one circumstance pertaining to this motion with which you will acquaint yourselves in my present lecture. So firm was my conviction of the diurnal and annual revolutions of our globe that I had accepted even Foucault's experiments with the pendulum as sufficiently demonstrative.

Meanwhile, I had been appointed to assist in the experiments, and, as they bear directly upon the subject in hand, I will briefly state in substance the results.

If, choosing any given point in space near our globe, we imagine a limitless series of circles, then, in consequence of their parallel position to the equator, we term such series of circles parallels.

From the exterior form of the earth we conclude that these circles go on diminishing as they near the poles. If we fancy two such circumterraneous parallels as dividing this auditorium, then the northern parallel will be shorter than the southern. In the rotation of the earth around its axis in 24 hours both parallels will have to accomplish their rotation in the same space of time; and as they complete the circuit simultaneously, but the southern parallel is longer than the northern, then, consequently, every point of the southern parallel must move with greater velocity than the like points of the northern.

Let us now throw a glance on the apparatus called the pendulum, which is well known to every one, but in the particular case in point a very equivocal authority. It is easy to demonstrate that the arc of the vibration of the pendulum does not depend upon the change (Drehung) of the point of suspension. This undisturbed regularity of the vibration of the pendulum has served M. Léon Foucault as a proof of the rotation of the earth around its axis. If we cause such a pendulum to vibrate across the parallels which we are imagining to pass through our audience, then the arc of the vibration, as Foucault tells us, will not change from the axial rotation of the emplacement, and will begin, in consequence of this, to gain in rapidity on the northern and less rapidly moving parallel, and will be outstripped by the southern one, which moves quicker. In such a case, the arc of the pendulum will soon diverge from its direction from north to south, and its point turned to the north will near the east, and with the point turned south will begin more and more to near the west, till, finally, the pendulum will change its motion in the direction from east to west.

Now the reason for a deviation of the pendulum has ceased; it vibrates no more across the two parallels, but only across one. The cause of its deviation from its first direction is removed; it would then seem that the deviation itself ought not to take place any longer, but nevertheless it still continues. The pendulum abandons the east and west direction to approach with its points the southeast and northwest until it reaches its starting point, at which it must again deviate according to Foucault's theory.

As the pendulum does not preserve the direction from east to west, but always gets farther and farther away, I conclude that the deviation of the pendulum is not caused by the axial motion of the earth, but due to some other reason as yet unknown.

By a series of careful experiments I have found that all pendulums are not liable to a deviation in the same degree; the heavier the ball, the more rapidly it will deviate. And as the rotation of the earth around its axis—if we admit its existence—ought to be manifested everywhere equally, then its deviation also, for every kind of pendulum, must be equal in time: but this in reality is just what is not the case.

The conviction that Foucault's arguments were erroneous forced me to verify at the same time all other proofs which have hitherto been regarded as demonstrating the rotation of the earth around its axis, and it was then I found that we had no evidence for such a theory.

Already in antiquity Aristarchus of Samos and other philosophers several centuries before Christ affirmed that the stellar sphere is motionless and that the daily rising and setting of the stars can only be accounted for on the theory of the earth's rotation around its axis. But all these men, profound thinkers, had come to the above conclusion only from the fact that otherwise such an incredible rapidity of the celestial bodies as would enable them to accomplish a diurnal circuit around the earth could never be accounted for. Of course every one must agree with me that at the present moment such an argument would be regarded as very small proof. Indeed, if we were to take a little peasant boy from a country in which railroads were unknown, and tell him of the existence of carriages which are able to make a mile in five minutes, of course he could never believe us; such rapidity would seem incredible to him. He is ignorant that light travels with a velocity of 40,000 miles a second, and that the rapidity of electricity is still more considerable! Thus, this argument with respect to the celestial bodies, whose nature is as yet so little understood, and the path of whose motion in a vacuum or in a space filled with attenuated matter is only assumed or guessed at upon the strength of an hypothesis—that these bodies cannot have such a velocity of motion as to be able in twenty-four hours to circumscribe the earth—such an argument, to make us reject the possibility of the rotation of the celestial sphere, is certainly weak and futile.

But the contrary position, the one commonly accepted, also proves untenable when we look into it carefully.

It was found in the measurement of the earthly meridians that the globe is flattened toward the poles, and, that in consequence of this, the equatorial diameter is greater than the line which passes through the axis of the earth from one pole to the other. Man, who endeavors to penetrate into all the mysteries of nature, tried to find the reason for such a flatness, and then comes Newton and explains it by the rotatory motion of the globe. In consequence of such a rotation all the component parts of the earth, and especially the bodies to be found upon its surface, receive an impulse to abandon the earth. Such an impulse is then named the centrifugal force.

At the poles, where the rapidity of the motion is equal to 0, that force is also equal to 0; further from the poles to the equator that force increases in ratio with the increase of the parallels, so that the greater the parallel is, the more rapidly, as I have already said, must move each of its points. In consequence of this, they say, the greater part of the earth's mass is gravitating toward the equator; and, for the same reason, the centripetal force, acting on the equator with greatest intensity, compels the concentration there of the greater portion of the mass. Hence, it is finally concluded that the earth must forcibly rotate around its axis, because were there no such rotation there would be no centrifugal force, and without such a force there would exist no gravitation toward the equatorial diameter or zone.

We have laid before you now one of the existing evidences of the rotation of the earth. I do not accept such an argument, but reject it with many other scientists who have discarded it before myself.

I will not seek to controvert at present the exactitude of the measurements of the degrees, although all agree but little with each other. Let us rather accept for a certainty that the diameter of the equatorial circumference is greater than the axial diameter. But have we not, even in this case, more exact theories to explain the cause of the accumulation of the earth-mass on the equatorial latitudes? Every one knows that heat contains an expansive force and cold a contractile one. Why not infer that the heat at the tropics, acting during a whole series of ages, or from the creation of the world, has effected a continuous expansion of the equatorial latitudes, and the cold at the poles a coincident contraction of the polar zone?

But there exists another and more sure hypothesis with which it is possible to explain the reason of the enormous accumulation of the earth-mass on the equator. It would appear that our globe is chiefly occupied with its progressive growth; toward this growth much is contributed by the animal and vegetable kingdoms. There is no occasion to speak now of the colossal coal deposits found at considerable depths, and which could be found at still greater depths were we possessed of the means to reach them. I might also say something of those microscopical creatures from whose remains are formed whole mountain ranges and whole geological strata; but I will limit myself to reminding you of those turf bogs which are found self-formed sometimes on the highest mountains; I will remind you how our agriculturists, knowing that a layer of soil is obtained from the decay of grass, to make such a soil spread turf on rocky bottoms; and now a query: Where should the growth of our globe proceed more surely—is it in warm regions, which teem with animal and vegetable life, or in those colder regions where existence is full of necessities which gradually increase as we approach the poles?

Therefore, gentlemen, until we have more weighty arguments to explain satisfactorily the accumulation of the mass of earthy matter on the warmer zones, I cannot undertake to accept as a reason for it a certain centrifugal force, appearing as a consequence of the motion of the earth around its axis, and I will not allow the hypothesis, were it but because I know beforehand to what inextricable contradictions this centrifugal force would bring us. Some of these I will point out presently.

We will now consider the fourth and last evidence of the rotary movement of the terrestrial globe.

In 1867 M. Richer remarked that a clock of his, which kept good time in Paris, having been transferred to Cayenne, *i. e.*, five degrees north of the equator, began to lose two and a half minutes daily. Richer had to shorten the rod of the pendulum one and a quarter lines to make the clock go right. It is well known that the time of the vibration or rapidity of a pendulum increases with the diminution of its length, and is arrested proportionately with the elongation of the rod. Later it was ascertained that such a retardation happens also when the clock is carried on a high mountain. As the vibration of the pendulum is based on the laws of falling bodies, and the fall of the bodies itself depends on their weight, or, otherwise, on the attraction of the earth, it was but natural to conclude that if the vibration of the pendulum is not the same everywhere, and the attraction of the earth varies, then this affords us conclusive evidence that the cause of the retardation of the vibrations of the pendulum is a certain centrifugal force, which develops with the motion of the earth around its axis, and that it is this force which arrests the swing of the pendulum by decreasing its weight. But such a conclusion is erroneous; and we could far better admit the following conclusion, at which many of our physicists now have arrived—the attraction of the earth diminishes with the recession of the body from its center, which serves at the same time as a center for all the attractive force of our globe.

And what if the cause of the retardation of the vibrations of the pendulum at the equator and on high mountains should prove quite different from what is now generally supposed? What if the cause is not at all the decrease of the force of attraction (whether from the recession of the object from the center of the earth or centrifugal force), but, on the contrary, its increase, proceeding from the accumulation of bulk at the equator, in which case the force of attraction increasing, increases at the same time the weight of the body, and in the pendulum the weight of the ball? There is one fact not known to all physicists, I believe, namely, that the rapidity of the vibrations of a pendulum depends not only on the length of its rod, but also on the weight of the ball itself. It might be even more correct to express it thus: the velocity of the motion of the pendulum depends chiefly on the weight of its ball. When I elongate the rod of the pendulum I force the ball to move on a longer level, and increase thereby its own weight; I can also, without elongating the rod, increase its weight by other means; the result will be the same. Thus, for instance, every one is aware that even people unacquainted with science, when their clocks are running too fast, and they wish to make the pendulum vibrate slower, attach to the ball either a stone or a small bit of iron, and thus attain their object. The physicists have made very exact experiments in this direction. They found that a pendulum having an uniform length of rod makes 20,000 vibrations—

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| With a ball attached to it weighing | 2 k.g. | in | 1,977 | seconds. |
| " " " | 4 " | " | 2,010.55 | " |
| " " " | 6 " | " | 2,021.31 | " |
| " " " | 8 " | " | 2,027.04 | " |

Therefore the greater the weight of the ball the slower the vibration of the pendulum. From these experiments, conducted with the greatest precautions and published in the "*Comptes Rendus de l'Academie Francaise*," tome xxi., pp. 117–124, it appears: 1, That the laws of Galileo are not quite exact as to the vibrations of the pendulum; 2, That the explanation of the retardation of the pendulum on the equator by the decrease of the force of attraction of the earth is evidently false; 3, That even the universally accepted laws of the gravitation of bodies are not sufficiently exact; and 4, That, in general, the means employed toward discovering the laws of nature with the help of calculations is not only being proved unreliable, but it serves but the more to darken the truth.

You will have seen from the last two arguments, which have hitherto served as evidence of the rotation of the earth, that as the result of such a rotation was assumed a certain centrifugal force. Its presence was vainly sought for in the currents of the ocean, as well as in those of the air. And, indeed, it is not easy to explain how or on what principle the air—this soft, yielding, incompressible body, agitated by various currents—could have remained unaffected by the rotation of the terrestrial globe. If the greatest physicists admit that hard bodies are influenced by such a rotation, then, it appears, it will not be too bold on my part to maintain that the rotation of the earth around its axis should inevitably exert an influence on the air. This influence would be shown first of all in that, during the rotation of the earth from west to east, there would appear immediately an atmospheric current from east to west.

Indeed, if the earth, together with its atmosphere, rotates in a completely empty space, then in every case it might be possible to admit that the earth rotates without producing any influence on the atmospheric ocean. But against the theory of such a vacuum we have the very quality of the air.

The air, as much as we know of it, has such a great tendency toward expansion that all the hitherto worked-out laws of gravitation have remained foreign to it. Were the most exterior, the most rarefied layer of air not to encounter on its way any obstacle toward its expansion in the shape of a new planet, it would scatter itself throughout the whole universe, moving farther and farther into the infinite space; the particles of the air nearer to this layer would follow its example, and, finally, the seas and rivers of the terrestrial globe, all the water would take part in such a process of expansion, to disappear at last from the face of the earth. (We produce first just such a phenomenon with the help of an air pump.) On the ground that such a thing does not exist in fact, we must suppose that there is some retaining cause, which, according to custom, we will term Ether. Counteraction to the evaporation of the air consists in this, that it forces every upper layer to press upon the next lower, causing by such a progressive pressure the condensation of that layer of the atmospheric air which is next to us.

If such an ether exists in reality, then there must occur in the atmosphere those phenomena so familiar to us which always take place in cases when the air encounters obstacles to its free motion. Let the earth rotate, then all the atmospheric space, on the ground of the attraction of the earth, will be compelled to participate in the movement, and the consequence will be that the upper layers of the air, finding a resistance in the ether, will either be retarded, or—which would be the same—assume a seeming current in a direction opposite to that of the earth's motion. Such a current of the upper stratum of the air would provoke a resistance in the next lower one, and this one, in its turn, receiving the impulse communicated to it by the upper one, would offer a resistance to its next lower neighbor, etc. Finally these two opposite currents, interminglings in their onward impulse, would form two streams—one from east to west, in which would participate, first, the whole atmospheric ocean world, and then the contents of all the watery basins; the other from west to east, into which would be drawn the very core of the terrestrial globe.

But let us make another supposition, and, notwithstanding the impossibility, let us admit that there is *no* ether; that ether is no more or less than the product of those endless hypotheses in which man has entangled himself from the first in his efforts to investigate nature; even in the latter case it will not be a difficult task to prove that the rotation of the earth must cause the current of the atmosphere to take an opposite direction. On what ground did our physicists base their suppositions when telling us that we do not feel the rotation of the earth? How do they explain the circumstance that objects on its surface are neither upset nor fall? They point us to the laws of inertia. Very well! I agree with them! I agree only the better to vanquish my adversaries with their own weapons, as I have hitherto always done. You are probably aware that motion can be imparted to any substance, but that a fluid or gaseous body can be made to move only when it is imprisoned in a hard one. Air is a body which is more than any other dissociated as to its component parts. Let us suppose that the earth has communicated its movement to the layer of air next to the surface, and thus dragged it after her. This layer, perfectly separate and distinct from the next upper one unattached to it, is unable to communicate its motion to the other and upper layers. Hence these upper layers remain unaffected by the motion of the lower one, or, what comes to the same, begin to assume a *seeming* rush (or current) from east to west, with a rapidity equal to the earth's rotation. Every point of the equator during the diurnal rotation of the earth crosses in the same lapse of time 1,250 feet, but in a direction opposite to that of the earth's rotation. But such a rapidity of the atmospheric currents is nowhere to be seen, and it exceeds ten times the speed of the most terrible hurricanes.

I do not belong to those who accept their own conviction of an east and west atmospheric current for a real and already demonstrated fact. And yet all the modern physicists, scientifically convinced of the absolute necessity for the existence of such a current, have accepted it as a fact, resulting from the earth's rotation around its axis, although all their efforts to find it anywhere in nature have been in vain. Even the *passates*, explained for a certain time by the same rotatory motion of our globe, deprived at the present moment of their once famous periodicity, are now being accounted for a great deal more simply, to wit, by the different degree of heat in the upper envelope of the terrestrial globe.

We have but to represent to ourselves, in thought, all the various atmospheric currents, at one time weakening, at another increasing, and moving in every imaginable direction, called by us sometimes winds, sometimes tempests; we must imagine these winds running very often in direct opposition to each other's course, and then ask ourselves the question: Is there any possibility that such currents could exist when the air is at the same time forced to passively follow the simultaneous rotation of the earth around the sun and its own axis? Is it possible to admit that in case such currents existed in nature, our atmosphere would at the same time continue the constant and faithful satellite of our earth?

Therefore the circumstance that the rotation of the earth around its axis is not at all felt by us; that other circumstance, that this rotation has never been in any form or manner satisfactorily proved, and *cannot* be proved; the absence, finally, in nature, of those atmospheric currents which in all justice ought to be found as a consequence of the rotation—all this serves us as a refutation of the theory of the rotation of the earth around its axis, perfectly convincing, if it were only because we do not possess a single evident proof in favor of the rotation.

Is it not a cause of wonder that the *savants* of the whole civilized world, beginning with Copernicus and ending with Kepler, first of all accept such a rotation of our planet, and then for three centuries and a half after that seek for it some proof? But, alas! they seek, and, as was to be expected, find it not. All is vain; all unsuccessful!

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To prove the impossibility of the second proposition, *i. e.*, the revolution of the earth around the sun, will present no difficulty. We can bring self-evident proof to the contrary.

*The earth revolves around the sun and is retained in its orbit by the strength of the solar attraction*, and these propositions contradict, point blank, the fundamental law of gravitation itself. It is known to every one that the direction of the weight of every body must always be perpendicular to the center of attraction of another body. So, for instance, a grain of dust on a smooth wall sticks to the latter because the direction of its weight is perpendicular to the wall, otherwise the grain of dust would fall. In the same way the direction of the weight of our planet must be perpendicular to the sun, as to the center of its attraction. But such, in fact, is not the case at all. The direction of the earth's weight is not only not perpendicular, but even changes with every moment.

In order to prove the correctness of my observation, we will now examine more carefully the modern theory of the annual rotation of the earth around the sun, and we will examine it under the aspect in which it is treated in the scientific works that discuss this subject.

To explain the change of seasons, in other words to demonstrate the solar ecliptic, the scientists have assumed the following position: The earth's axis inclines to its orbit at an angle of 66½ degrees; this angle is preserved by the earth during the whole time of its rotation around the sun, *i. e.*, the axis of the earth is parallel to itself at every point of its transit.

We can make this theory approximately clear to ourselves by the following illustration: Taking this candle for the sun, we will now revolve around it this little globe, so that, by a simple, practical experiment, we may form for ourselves an idea how the four seasons take place.

In March the terrestrial axis (Fig. 1, A) inclines toward its orbit, and the whole of it, from one pole to another, is turned toward the sun. The terrestrial equator rotates in a plane perpendicular to the sun's disk. As to the sun, it appears on the equator of the heavens, lighting up the earth from one pole to another, the meridian serving as a limit to such illumination.

Then everywhere on earth the days and nights become equal in time; every region crosses one half of its diurnal parallel in twelve hours in the light of the sun, the other half in darkness. Summer appears at the equator; in the northern hemisphere spring begins; in the southern, autumn.

From March to June the northern pole of the earth, preserving its inclination toward the orbit of the earth, turns little by little toward the sun; this goes on till the sun, on June 21st (Fig. 1, W), has assumed a perpendicular position in relation to the plane which passes through the northern polar circle. In the northern hemisphere is summer; in the southern, winter.

From June to September the axis of the earth returns to its first position, *i. e.*, inclining and turned toward the sun, and, therefore, toward the 23d September (Fig. 1, B), the terrestrial globe is again lit up as on March 21st, *i. e.*, the sun becomes perpendicular to the equator, and gives it a second time summer; to the northern hemisphere autumn; to the southern, spring.

From September to December the earth's axis turns its southern pole to the sun, so that the latter becomes, on the 21st December (Fig. 1, O), perpendicular to the parallel of Capricorn.

Then the earth is lighted up quite in an opposite way than it was lit up on the 21st of June; on the southern pole we have day; on the northern, night; in the southern hemisphere summer; in the northern, winter, with its long nights.

In the interval between December and March the axis of the earth returns to its first position.

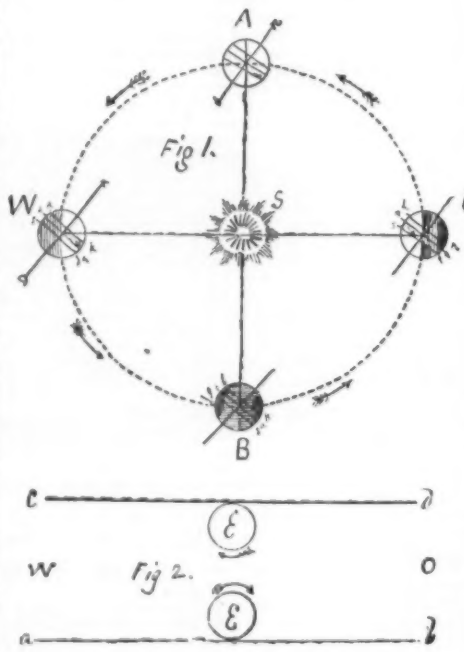
For a better illustration of the subject, we insert a diagram.

S in the center represents the sun. The dotted circle designates the orbit of the earth; and the arrows point in the direction of the earth's revolution around the sun. We see the terrestrial globe in four different positions, A, W, B, and O. W designates the west, and O the east; the little arrows show the diurnal rotation of the earth from west to east. The lines drawn across the circles, which are meant for the earth, represent, *a*, *a*, the equator; *k*, *k*, the northern, and *s*, *s*, the southern parallels; *n*, *s*, the axis of the earth. Near A the earth stands on the 21st of March; the axis of the earth inclines only toward its own orbit, therefore one whole half of the earth up to the meridian is lit by the sun. At W the terrestrial globe stands on the 21st of June; the earth's axis, remaining inclined toward its orbit, deviates with its southern pole from the sun, and approaches it with the northern, therefore the greater portion of the northern polar circle enjoys light, and the greater portion of the southern is in utter darkness. B represents the earth on the 22d of September. On the diagram is represented that half of the earth which is not turned toward the sun up to the meridian, therefore it is shaded, as it is not lighted by the sun.

Finally, at O is represented the earth on the 21st of December; the southern pole is inclined toward the sun and the earthly orbit; the northern is turned away from the sun. Here on the diagram we can plainly see that the axis of the earth does not change its position with relation to the earth's orbit during the whole time of the earth's rotation, *i. e.*, it remains parallel to itself. It is only by conceding this that we can explain the four seasons of the year.

To this point the modern theory appears perfectly satisfactory, but if we examine it more carefully, its inconsistency will become evident. Thus I will now touch at once that incomprehensible and, at the first glance, unobserved circumstance, which has always appeared to me absurd, whenever I had to explain to my audience the rotation of the earth around the sun.

As it would be absurd to suppose that the sun, during the yearly revolution of the earth, in its turn daily circumscribes the earth, modern theory, to meet the necessity of the case, has to suppose that the terrestrial globe, while rotating yearly around the sun, turns daily around its own axis in the direction from west to east. But such two simultaneous rotations are, as we shall directly see, perfectly inadmissible. During the interval from the 21st of June to the 22d of September such two simultaneous motions coincide well enough (Fig. 1, from W to B), but from the 22d of September onward, and back to the 21st of June, the juxtaposition of such two motions carries us on directly to a perfect absurdity; it would follow that the terrestrial globe, rotating diurnally around its axis from west to east, moves onward in a direction quite the opposite. But I believe that every one is aware that a moving body, according to the nature of its rotatory motion, either receives an impulse forward, or, on the contrary, the impulse forward directs its rotatory motion. Consequently, if the terrestrial globe rotates from west to east, then it must also proceed onward in the same direction, and, in the case of a sudden appearance of some new force, compelling the earth to deviate from its primal direction, the force which makes the earth to move around its axis must (if it is the stronger) either overcome the newly manifested force or be destroyed by it.




## DEFINITE CONDLUSIONS OF SCIENCE—OUR EARTH MOTIONLESS.

If we compare the two halves (or parts) of the terrestrial revolution around the sun, to wit, the semi-revolution from W to O, through B, with the semi-revolution from O to W, through A, we will find that, from W to O, the direction of the rotation agrees to a certain point with the direction of the motion, and from O to W it is directly opposite to its onward motion. (This will best be seen if we rotate this sphere around the lighted candle in the same manner as represented for the earth in Fig 1.) In order to explain such a strange contradiction, we ought to suppose that, during the revolution of the earth around the sun, the direction of the terrestrial weight is also changed, but this would amount to an absurdity, and something in direct contradiction to the accepted formula, that the direction of the terrestrial weight depends on the sun, as on a body which keeps the earth in its orbit. Fig. 2 will explain the whole still plainer. If the globe, E, is compelled to rotate toward O, in the direction pointed to by the arrow, and move onward from *a* to *b*, and from *d* to *c*, then, in its motion from W to O, it must have the direction of its weight on the line *a*, *b*, and in its motion from O to W, on the line *c*, *d*, to wit, in the first case, have its weight directed downward, and in the second case upward. Although in the universal space there exists neither an up nor down, the question itself is unaffected by that circumstance. Presently we will return once more to this question, and prove that such an incessant change of the direction of the terrestrial weight is in direct contradiction with science.

According to the now prevailing modern view, the earth is kept within its orbit by the force of the sun's attraction. But even this proposition contradicts the assumption of the dual rotation of the earth, unless we make such allowances as will contradict all our scientific notions, for it is impossible to imagine to ourselves two simultaneous motions of the terrestrial globe around its axis, and around the sun, in agreement with the change of years and that of the seasons, during which the direction of the terrestrial weight would be constantly turned toward the sun, as we ought to find it were the earth supported in its orbit by the force of the attraction of the sun.

It is supposed that in every circuitous motion there are two forces in action. For instance, if we attach a ball to a string, and swing it around so that the cord will be extended out straight, then the one force, which tends to project the ball in a straight line from the center, is named centrifugal force, and the other, contained in the very cord itself, shows a tendency to draw back the ball toward the center round which it revolves, and is called centripetal force. During the simultaneous activity of both the forces the ball cannot move on a direct line on which both forces tend to move it, but is forced to adopt a movement in the direction of a diagonal, and, from the union of an infinite number of such diagonals, it begins moving in a circle.

If we examine a little more carefully this circuit-motion of the ball, we will find it anything but complex. That point of the ball to which is attached the cord, *i. e.*, near which acts the centripetal force developed by my hand, lies on that side of the ball which is directed to the center of the movement, *i. e.*, in the direction of the hand, and, if the ball had a propensity at the same time to assume a motion around its axis, then the latter would find itself at the same spot where the thread is tied, and this given point on the ball ought to remain turned toward the hand.

That which is law for one body is law for all other bodies, placed in the same conditions as the first. The moon—the only heavenly body so close to our planet as that we can observe it in detail—is placed, in relation to her revolution around the earth, under precisely the same conditions as the ball we are now examining is, in relation to the point where the thread is fixed. Let us fancy the ball as the moon, the hand as the earth, and the thread as the terrestrial attraction, invisible in reality, but acting like the thread, and we will see that the moon is turned toward our globe always on the same side, for the force of attraction has deprived it forever of the slightest possibility to effect any change in the direction of the weight and rotation around the axis. Why, then, not derive from the laws of motion regulating the moon a very close deduction for our own planet? Indeed, if the terrestrial globe revolves around the sun, and is kept in suspension in its orbit through the attraction of the sun, then this globe, as well as the moon, must find it impossible to rotate around its axis. In such a case, the one side of the earth would be constantly lighted by the sun, while the other would find itself in perpetual darkness.

But we see no such thing, therefore we must infer that the modern explanations of the movements of our planet around its axis and the sun are devoid of the least probability, and disagree entirely with the exigencies of experiment.

Perhaps we might suppose that the terrestrial globe, occupying a central position, revolves in twenty-four hours around its axis, while the sun describes annually above it that circle which is shown by the ecliptic. But there is no room for such a supposition until the rotation of the earth itself around its axis is demonstrated on more solid proofs; and, besides, as I have shown, it is the contrary, which can be most easily proved.

The immobility of our planet is chiefly maintained by me on the principle that we cannot find in nature any constant atmospheric current always running from east to west. On the same principle, if our planet revolved around the sun, its whole atmosphere ought to be retarded and forced in a direction contrary to the forward motion of the earth, and would have to follow our planet like a long tail, as we see in the case with comets. Of whatever substance may be the tail of the latter, we are forced to examine it as the atmosphere of these as yet but little known bodies, and if the comets themselves travel in the universal space, then their atmosphere is compelled to follow them in the shape of a luminous tail.

Finally, let us return once more to the law of gravitation in order to demonstrate conclusively that the rotation of the earth around its axis and the sun is an utterly improbable hypothesis. A little further back, while repeating to you in substance the theory now thoroughly accepted of the earth's revolution, I have shown that, as the theory now stands, the position of the terrestrial weight must inevitably be shifting at every second. Out of this would result the following: If the sun really retains the terrestrial globe in its orbit, then the direction of the terrestrial gravity must constantly tend from the center of the earth toward the point fixed on its surface at that side which is turned to the sun; on this point acts, immediately, all the centripetal force proceeding from the sun, and, therefore, as in the instance of the moon when the center of all the lunar gravity is concentrated on that side of her which is turned to us, it is to this point that must gravitate all the weight of the terrestrial globe as all the weaker and lighter bodies. But our experiments show to us quite the contrary: the center of the earth's gravity does not change in the least, and, placed in its middle, depends only on the terrestrial mass; no outward force of the kind of the sun's attraction is able to affect it in any way, or can force it to displace itself. And if so, then do not such facts prove fully and clearly (1) that the terrestrial globe is not kept in its orbit by the sun's attraction, because such an enormous force could not but affect the point where is concentrated the center of the earth's gravity; and (2) that the center of the earth is at the same time the center of its weight, and also the center of all the visible universe?

Of course, I do not reject entirely the influence on our planet not only of the attraction of the sun, but also of the moon, but I only maintain that the force of their attraction is not so powerful as to influence, in any serious way, the solid portions of the terrestrial body, when we find that even with fluid and gaseous bodies, especially such as the air, this influence is felt but to a very feeble extent. If the attraction of the sun is so trifling that it can act but in quite a slight and to us as yet not quite clear manner on fluidic bodies, then we have still less reason to suppose that such a weak force could neutralize the centrifugal force of the earth and keep it in its orbit. For such an effect as this a force of gigantic proportion would be required—a force under whose action all the terrestrial atmosphere would long since have been carried off to the sun, in the same way as the force of attraction of the terrestrial globe is ever ready to attract to itself every just forming lunar atmosphere.

Let us now see what changes would be called for in the department of astronomy were my assertions to be some day verified, and it should be found that the earth is motionless, and occupies the central position of the visible universe. Such changes would be in some respects important, in others unimportant. They would chiefly consist in our henceforth regarding the hitherto seeming motion of the heavenly bodies as a real motion, as the astronomer Tycho de Brahé did before. He maintained that the earth stands still in the center of the universe, and around it, as around its natural center, moves diurnally the whole heavenly sphere; the moon and the sun in addition to the above motion describing around the earth independent movements on special curves, while Mercury with the rest of the planets describes an epicycloid.

Thus what is most essential in astronomy would remain unchanged, as for our calculations it is perfectly immaterial whether we explain the motion of the planets by the rotation of the earth or that of the celestial sphere; but certain things perhaps less important will assuredly have to pass away into the realm of myth.

I may also add that the position assumed by our scientists who consider the fixed stars as suns of the same nature as our own, and all the other planets as bodies identical in substance with our earth, will be found to be without foundation. Such a theory is irrational, if it were only because of the principles on which are based the determination of circumferences and weights of the celestial bodies. The weight of the sun, for instance, was determined in accordance with the amount of the expression of its imaginary attractive force on the surrounding planets. As soon as it is found that the sun must surrender its office of principal star and become simply a planet revolving around the earth, directly depending on the force of the latter's attraction, all previous calculations will naturally be proved erroneous.

The sizes of the heavenly bodies have been determined on no less false principle.

Who but is more or less acquainted with that phenomenon which shows us an object diminishing in proportion to the distance, so that if an object is placed at a distance which exceeds 5,000 times its diameter, the human eye is unable to see that object? It is on the basis of this law that the sizes of all the heavenly bodies have been calculated. According to their seeming size and the ratio of their distance from the earth, science has endeavored to determine the number of times that their real size surpasses their seeming one. But in determining by that principle our scientists have neglected to consider one of the most important points; they forget that the law which makes objects apparently diminishing in proportion to their distance from the observer does not affect luminous bodies; the brighter the light of the body the longer its bulk will remain unchanged in our sight, whereas an object but faintly lighted becomes invisible, as I have said, at a distance which exceeds its diameter 5,000 times. If the said law extended to luminous bodies, then a flame one inch wide could not be seen at the distance of 225 yards, whereas we know from experiment that the size of its apparent bulk does not change even when the candle is carried to a distance of several thousand yards.

As the sunlight is extremely bright, the bulk of the sun must therefore seem unchangeable at an extremely long distance, and it is very possible that the sun in reality is but little bigger than it seems to us at a distance. Besides that, it is not only possible but a great deal more plausible to accept the assumption that the laws which show to us an object diminishing with the distance are applicable only to our own dense atmosphere which surrounds us, and are not operative in a medium so rare as that of the upper spheres.

When, after a clear and cold night, the vapors of the air are drawn down to the earth, and the rising sun illuminates the air now cleared from the mist, then the mountains, the villages, the environs and edifices, at other times hardly delineated in the bluish atmosphere, suddenly rise before our eyes as if growing up by enchantment; they seem nearer and allow us to examine the slightest details of their structure. In this case the law of the diminution of objects is evidently changed. And there in the ether, in that attenuated matter —or rather let us only speak of ether as empty space—in this vacuum of the universe how can these laws be ever applied? Generally speaking, as far as I know from personal experience, the science of optics is not quite accurate, the sight of the human eye is more or less influenced by the purity of the atmospheric air.

The same as to the calculations derived from the measurement of the shadow thrown by the earth on the moon, during the lunar eclipses. I cannot accept them as correct, until I am shown to my satisfaction that the laws of the refraction of the rays of light in the universal space are perfectly correct.

Equally erroneous will be found all the determinations of distances of the fixed stars, once that we have to regard the earth as fixed. According to the now accepted and wholly dominant theory, on the 21st of December the earth is at a distance of just 40,000,000 miles from the point at which it stood on the 21st of July. On these same dates, with the help of the same telescope, directed to one and the same point of the heavens, is observed a certain star which crosses the meridian in the same direction and in the same point of the heavens. It results then that a distance of 40,000,000 of miles counts as nothing in our comparison of the distance of the observed star! But even such an evident proof of the recision of the fixed stars from the earth loses certainly all its weight if we assume the earth to be motionless.

And now, gentlemen, allow me to lay before you one more contradiction, which, had it been insisted upon before, might have shown to our scientists long ago the erroneousness of our astronomical calculation.

It was found from the determination of the sun's attraction that every body which exerts on the terrestrial globe a pressure of one pound exerts on the sun a pressure of 27 pounds. If all bodies act on the sun with such an increased pressure, it would then seem that the mass of the sun ought to be likewise and in the same proportion more compact than the terrestrial mass, *i. e.*, it would consist of a more dense matter; and yet, by comparing the calculations of the weight with those of the circumference of the sun, it has been found that the sun's matter is just four times less in density than the substance out of which the earth is formed. The result, then, would be that one and the same body would weigh on the sun 27 times more than when on earth, and its weight would act on the sun 108 times more than it would on our planet; and yet the substance of the sun would present but ¼ of a part of the density of the matter of the terrestrial globe. This, I must say, is incomprehensible to me, and I view such a theory as the result of correct calculations based on a false principle.

I also deny the existence of the atmosphere on any planet whatever. A heavenly body crossing the universe with a velocity hardly comprehensible cannot be possessed of an atmosphere similar to the air of our earth. And here, as before, the moon—a planet with the qualities with which we are best acquainted—gives us a fully correct comprehension, or rather it corroborates all that is shown to us by the natural laws. The moon has no atmosphere, and, therefore, there is but little probability that the other planets would have any more than she has. All the observations tending to show that the moon must have an atmosphere are based, no doubt, on equally erroneous principles; they could be accepted with any degree of certainty only when the experimenter could be carried beyond the atmosphere of the earth, or, at the least, when we should build our observations on the summit of Dhawalaghiri.

The outer surfaces of the body of the sun, moon, and other planets cannot be similar in appearance to the surface of the terrestrial globe; they must consist of strongly compacted matter, such as we see sometimes in the substance of the frequently falling aerolites. All the non-solid bodies, the strata of the earth, and the rocky portions would be torn off and precipitated on the earth by the force of its attraction. Thus, on the ground of these premises, the assumption that some of the planets may be inhabited is void of any probability and has to pass into the realm of fiction.

It now becomes clear how the scientists have been forced to such contradictory astronomical hypotheses. The stars were disposed by the Creator of the universe at such considerable distances from each other probably with the view of enabling them to light up at once the immense spaces of the firmament.

Man, while determining the distance of the stars most important to us, on the strength of an imaginary rule of distance and falsely applied laws of the diminution of objects in proportion to their recession, began to calculate the size of these stars, and, astonished at their dimensions, mistook the fixed stars for bodies similar to our sun, and our earth for a very unimportant portion of the whole universe. Arrived at the latter conclusion, it very naturally appeared absurd to him that all these powerful, all these gigantic and numerous celestial bodies should revolve around our little globe, obey it, and submit to its desires. At that time appeared a new hypothesis: the earth is not motionless, it revolves around itself and around the sun. This theory is accepted as the correct one, and step after step are now built new suppositions, new combinations deduced from the union and combination of imagination with correct mathematical calculations.

Here I will end my dissertation, although it would be but a too easy matter to point out a great many more contradictions on which rests the modern theory which I now combat and is opposed to mine.

We cannot help desiring and hoping that perchance there may be found at least one astronomer who, armed with all the weapons of modern speculative science and its apparatus, will undertake to re-create the whole system of Tycho de Brahé. The result of such an attempt would doubtless prove something scientifically grand. All that now under the Copernican system appears to us so incomprehensible and diametrically opposed to the fundamental laws of nature would be finally explained in the simplest and most rational way. We can now see how right was the venerated astronomer Bandés, when, expressing his opinion on Tycho de Brahé's system, he remarked, "This theory presents in itself a great deal more of probability, as it explains so well all of the individual phenomena of nature." Unfortunately, Bandés was mistaken when he imagined that this system contradicted the laws of attraction. But I believe I have fully disposed of such a misunderstanding, and proved that it was not Tycho de Brahé's system, but that of Copernicus, which contradicts all the laws of gravitation.

To add a few more proofs to our assumption we will say:

1. That the form of the continents contradicts the theory of the rotation of the earth. If our globe were revolving around its axis, then the outlines of the continents ought to elongate themselves in a direction from east to west, when in reality this elongation of configuration extends from north to south.

Besides that, the width of their northern edges arises from the attractive force of the northern pole, and the points turned south from the repulsive force of the south pole.

2. There are no fixed stars in the sense of this word, because it has been observed that these stars, besides their diurnal revolution around the earth, perform independent circuitous movements. Vain have been all the efforts of the astronomers to find a central body whose force of attraction might account for the fact that these stars are kept within their orbits; and such a body must exist somewhere. This central body is our earth. May it not also explain the fact that the greater the accumulation of soil in the northern hemisphere the larger is the number of stars above?

3. Various changes in the fixed stars have been often remarked, namely, a change of color or of intensity of light, the sudden appearance and as sudden disappearance of single stars—which does not at all agree with the assumption that they are as large and independent bodies as it has been hitherto supposed.

4. The similarity in the component parts of all the meteorological masses, that is to say, of the bodies attracted by the force of gravity within the earth's atmosphere, gives us chiefly some idea of the composition of the mass of all the heavenly bodies, and proves that they cannot be inhabited. The greatest aerolites known to us had a diameter of 7 to 7½ feet.

5. According to the exact researches of Wilhelm Malman, in the middle latitudes of the temperate zone the prevailing atmospheric current appears to be W.S.W. Although agreeably with the law of terrestrial rotation the prevailing winds ought to be found in those regions easterly, we see the contrary and find them westerly.

As my following work will tend to demonstrate the agreement in the progression of the creation of the universe with truth and fact, and, taking into consideration that this pamphlet of mine (the only reasonable refutation of the earth's rotation) shows a similarity with the opinions of many scientists who preceded me, in conclusion I wish to quote a few words from Goethe. This poet, whose prophetic views remained during his life wholly unnoticed, said the following: "In whatever way or manner may have occurred this business, I must still say that I curse this modern theory of cosmogony, and hope that perchance there may appear in due time some young scientist of genius who will pick up courage enough to upset this universally disseminated delirium of lunatics. The most terrible thing in all this is that one is obliged to repeatedly hear the assurance that all the physicists adhere to the same opinion on this question. But one who is acquainted with men knows how it is done: good, intellectual, and courageous heads adorn their minds with such an idea for the sake of its probability; they gather followers and pupils, and thus form a literary power; their idea is finally worked out, exaggerated, and with a passionate impulse is forced upon society; hundreds and hundreds of noble-minded, reasonable people who work in other spheres, desiring to see their circle esteemed and dear to the interests of daily life, can do nothing better or more reasonable than to leave to other investigators their free scope of action, and add their voice in the benefit of that business which does not concern them at all. This is termed the universal corroboration of the truthfulness of an idea."

## PHOTO-CHROMO PICTURES.

If we correctly apprehend the method by which these pictures are now produced, it is as follows:—As many negatives are taken as there are colors in the subject to be reproduced in photochromie. From each negative is stopped out, by means of opaque varnish, every part except that which is required to be a certain color, such as neutral, green, red, blue, or yellow, each negative representing only one of these or other colors. Lichtdruck plates are now prepared, one from each of such negatives; and as each plate is capable of printing its own special color with all the delicate gradations of tone, from the faintest manifestation to the most intense rendering, very charming and natural effects may be obtained. The picture which is being printed receives an impression, in turn, from each of these collographic-printing surfaces, and when it has passed the last of these every portion of the subject will have been impressed.

Chromo-lithography is naturally suggested by this mode of proceeding; but this kind of photochromie differs from chromo-lithography, inasmuch as, while the former possesses all the advantage secured by correctness of registration of the colors, and the production of secondary and tertiary tints by the overlapping of those represented by special negatives, it possesses the further and immense advantage that each tint possesses in itself the smoothness and graduation of a silver photograph. The technical smoothness of photographic monotone is here *plus* color; and these colors may be of any degree of brightness or somberness thought desirable. The truthfulness and fidelity is that of a photograph, while the brilliancy of color and permanence are those associated with the printing inks made use of by the chromo-lithographic printer.

In the representation of articles in steel, silver, and gold the Vidal polychromes are marvelous. How are they produced? Our opinion is that in this department of photo-chromatic practice will be found at once the most effective and the simplest application of the new art. Suppose such an article as a shield, a helmet, or other piece of *repoussé* work in steel, is the subject to be represented: the ground upon which it is to be printed must be either silvered or tinned by methods known to workers in bronze powders. Upon this the design is printed, collographically, in monotone, the background obliterated by opaque ink, and the thing is at once done. An imprint of a transparent yellow or "aurine" color upon this converts any desired portions of it into gold or brass, as the case may be.

By stating that such effects may be produced easily we are so far from detracting from the merits of the process that we thus bestow upon it the highest commendation in our power. In order to demonstrate how very successfully the process is carried out we may refer to the shield of Henri II., in steel, and to the casque of the same monarch, which bear examination through a magnifying glass without dispelling the charm of the first impression. The royal scepter of Charlemagne is in gold, and contains a fine display of precious stones, for the representation of which M. Vidal's system of polychromie seems to offer peculiar advantages.

Examples of this class of work have already been exhibited at meetings of both the London photographic societies; and we are assured by the agents of the society under whose auspices they are published in this country that they will have pleasure in exhibiting them to all who choose to call for that purpose. Societies in provincial cities and towns are already aware that every facility is afforded to them for examining these the latest novelties in the art-department of photography.—*Brit. Jour. of Photography.*

## PHOTOGRAPHING INTERIORS.

By E. Lacan.

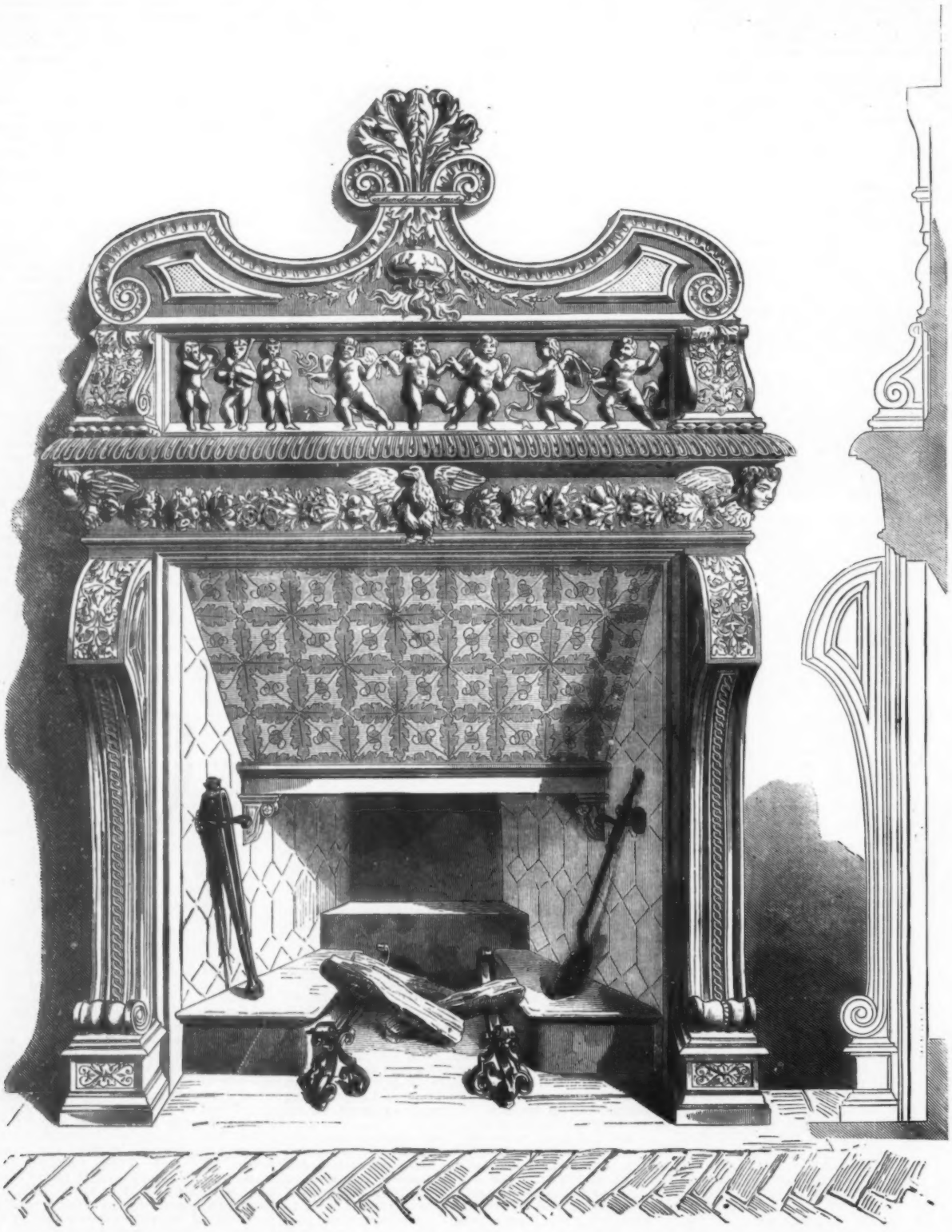
M. le Comte de Courten describes a method he has recently made use of in Italy to obtain rapid reproductions of objects illuminated by a weak light. M. de Courten employs sunlight for his purpose, which, by the aid of mirrors, must be reflected upon the object to be reproduced. The mirrors which he employs measure about sixty by eighty centimeters, and, by oscillating them in the least degree, it is possible to spread the light all over the object to be photographed. It is possible, indeed, to manipulate so that the more essential parts are more illuminated than the rest. M. de Courten tells me of many remarkable pictures which he has been able to reproduce in this way, among others the *faiences* of Luca della Robbia, which ornament the interior of the Palais Bargello at Florence. When the camera has been placed in position, and everything is ready for exposure, an assistant is placed at the nearest window with a mirror in his hand, and he directs the reflected rays upon the object in question. This produces an illumination from top to bottom, and although the lighting may seem to be irregular, the result is not the less satisfactory or less harmonious on that account. M. de Courten tells us that under great difficulties this mirror arrangement may be employed with success. Supposing it is desired to reproduce the details of a pulpit in a vast church, where, for instance, sunlight only enters direct from the top. In this case the luminous rays are reflected by a mirror installed near the door, and will have a long distance to travel to the object; therefore the hand will be found scarcely steady enough to keep the rays within the prescribed zone. By using two mirrors, however, and having recourse to double reflection, the matter is to be managed. The first mirror is placed near the door upon a support which permits of any suitable inclination, and allows it to be put into any definite position. It sends the rays coming from the exterior toward a point first of all fixed upon—for instance, five or six meters from the pulpit. At this point a person mounted upon a pair of steps, and holding the second mirror, is placed, and he will then reflect the rays in a suitable manner upon the object to be reproduced. This second mirror may be either a looking-glass or a silvered screen. In this way M. de Courten succeeded in rendering, by the aid of the camera, the pulpit in the Church of Santa Cross, in Florence. The rays of the sun near the entrance portal traveled a distance of twenty-five to thirty meters, and then encountered the second oscillating mirror, placed high enough to secure normal lighting. Thanks to this plan of proceeding, then, it is possible to overcome difficulties which at first appear to be almost insurmountable. It need scarcely be said that there must inevitably be a loss of light, but the actinic power of the solar rays twice reflected is still much more powerful than would be the electric or magnesium light.—*Photo. News.*

Naples-yellow is a pigment used by artists. It consists of antimoniate of lead, and is obtained by the direct combination of antimonic acid and oxide of lead under the influence of great heat.

## AN ITALIAN CHIMNEY PIECE.

OUR engraving illustrates an ornamental chimney piece in the Ducal Palace, Urbino, Italy, as represented in the *Workshop*.

The Ducal Palace in Urbino, built in the second half of the 15th century, enjoyed high renown by its grand disposition and princely splendor. Indeed the decorative carvings of chimney pieces, door frames and cornices which excite our admiration show great purity of design and delicacy of workmanship. This chimney piece, which has its place in the *Stanza del Re d'Inghilterra*, i. e., chamber of the King of England, is executed in white marble; from some vestiges of color and other analagous work yet well preserved we may conclude that the ground of the scroll work was painted blue, the ornament showing the natural color of the marble effectively relieved by some delicate gilding, ribs of leaves and other details being picked out in gold. Most of the structural parts also are richly gilt.



SUGGESTIONS FOR DECORATIVE ART. AN ITALIAN CHIMNEY PIECE IN MARBLE.

## SILVERING GLASS.

THE growing importance of reflecting surfaces for optical purposes renders it desirable that we should keep our readers well informed as to every development of the art of silvering glass. Mirrors silvered on their outer surface are, we need scarcely observe, now being extensively employed in the production of reversed negatives for various purposes in photography, the reversing prism having in most instances been superseded by the surface of silvered glass.

The method we have employed for several years is one with which (thanks to the lucid directions given by Mr. H. J. Burton in our Almanac for 1873) we have never experienced a failure. Further modifications—all tending to impart a greater degree of simplicity and certainty to the process—having been discovered by Mr. Burton, he embodied these in a second article on the subject in our Almanac for 1876. From that article we give the following extract, showing the manner of preparing and using the various solutions:

*Solution* 1.—

| | |
|---|---|
| Nitrate of silver | 25 grains. |
| Distilled water | 1 ounce. |

*Solution* 2.—

| | |
|---|---|
| Potash (pure) | 25 grains. |
| Distilled water | 1 ounce. |

*Solution A.*

Solution 1 } equal parts
Solution 2 }

Ammonia . . . to *just* dissolve the precipitate.
Solution 1 . . . to just cause a discoloration.

*Solution B.*—

| | |
|---|---|
| Loaf sugar | 2700 grains. |
| Distilled water | 20 ounces. |
| Nitric acid | 2 drachms. |
| Alcohol (strong) | 10 ounces. |
| Distilled water—to make | 80 " |

*For use.*—

| | |
|---|---|
| Solution A | 1 ounce. |
| Solution B | 1 drachm. |

"In preparing solution A do not be deceived at the time of adding the ammonia, as a little of the precipitate will not dissolve. If the liquid be clear sufficient has been added.

"*Precautions to be Observed in Carrying out the Process*.—Keep the solutions and dishes always in a warm room, or the deposit will be thin and black, instead of stout and bright. Dust the mirror after cleaning, and also the dish before pouring in the solution, or there will be a quantity of pinholes. Well mix the solutions before using, or the surface of the mirror may be mottled. Remove the mirror from the dish as soon as all the silver is deposited, or a bleaching action will commence. It may be known when the silver is all down by gently removing a little of the scum from off the surface of the liquid with a piece of paper and observing if the solution be clear; if so, the deposition has ended. Upon its removal from the dish the mirror must be well washed and dried off quickly upon blotting-paper, and finally warmed to about the same temperature as a negative that is about to be varnished with spirit varnish; and while still warm it should be polished. A little care is necessary when the polishing is commenced, and three soft and dry wash-leather pads should be made, kept separate, and marked Nos. 1, 2, and 3. No. 2 can be charged with the finest rouge, and beaten out again; the other two require no further treatment. Gently pass pad No. 1 in circular strokes over the newly-silvered mirror for five minutes, then pad No. 2, till properly polished, and finish off with pad No. 3. Keep the pads in tin boxes and quite dry.

"While a mirror is in use it requires to be frequently polished—say twice a week. Never let it get tarnished. Use the pads in the order as given above, and do not forget to warm the mirror before using the pads. Keep the mirror covered up when not in actual use."

As respects the keeping properties of these solutions Mr. Burton finds that A is subject to a slow decomposition, the silver being deposited upon the sides and bottom of the bot-

tle. On this account he prefers keeping the potash and the silver in two separate solutions. With regard to the other he says:

"Solution B, on the contrary, certainly improves by keeping. I am using some that is seven months old, and it works admirably. In using grape sugar as the reducing agent I have succeeded very well; but it is not so certain as my solution B, nor does it keep so well in solution."

At the last meeting of the Photographic Society of Great Britain, Captain Abney referred to a process of silvering he had employed with great success, by which, using the most ordinary care, he said it was impossible not to succeed. From Captain Abney's description of his method of working, given in the last number of the *Journal of the Photographic Society*, we make the annexed extract:

"The following is the formula given by Martin;

No. 1.—Silver nitrate ..... 17·5 grains.
Water (distilled) ..... 1 ounce.

No. 2.—Ammonium nitrate ..... 26·25 grains.
Water (distilled) ..... 1 ounce.

No. 3.—Caustic potash free from Cl and $CO_2$ ..... 4·4 grains.
Water (distilled) ..... 1 ounce.

No. 4.—Dissolve 44 grains of sugar in 10 ounces of distilled water, add 5·3 grains of tartaric acid, and boil for 10 minutes. Next add 2 ounces of alcohol, and add sufficient water to make up to 20 ounces if the silvering is to be done in winter, or to more if it is to be done in summer.

"The effect of tartaric acid in the sugar is to produce inverted sugar, which reduces the silver from the mixed solutions.

"In my own practice I use about 31 grains of ammonium nitrate, instead of 26·25 grains, the crystals being dried beforehand.

"The plate is cleaned with concentrated nitric acid, by the aid of cotton wool, perfectly free from all extraneous matter. It is then washed in distilled water and dried. Equal parts of No. 3 and alcohol are next applied, and while still wet the plate is placed in distilled water, and all the alkali rubbed off by a badger-hair brush. The plate is finally placed face downward in distilled water, resting on a couple of *clean* strips of glass.

"To prepare the silvering solution, equal parts of Nos. 1 and 2 are mixed in one measure, and the same quantities of 3 and 4 in another. The mixture in the second measure is poured into the first measure, and after thoroughly stirring the whole is transferred into a dish. The quantity should be so arranged that the solution just covers the bottom surface of the plate to be silvered when resting upon wedges (wooden ones covered with India-rubber solution will answer) about a quarter of an inch in height. The solution being poured in, the plate is placed in silver. If the mixture become blackly turbid at once it is probable there is not enough of No. 2 present, while if it remain clear for two or three minutes there is probably an excess. When the solution turns inky black the silvering commences, and the dish should then be rocked slightly for about five or ten minutes, when, if correctly made up, the solution should become clear and flakes of silver float up to the top. The glass will now be covered with a coating of silver, and it should appear perfectly bright if the chemicals are *pure*, and if the plate has not been left too long in the solution. The deposit should be very nearly opaque; any light passing through should be of a deep indigo color. There is often a little bloom on the surface, which, when the surface is dried, can be removed by a tuft of cotton wool. A surface which is slightly matt can be polished by a pad of *fine* chamois leather and a little jeweler's rouge. The pad should be warmed and the polishing done with a light hand. A green tint in the deposit indicates defective cleaning of the plate, while a purple tint indicates something wrong in the solutions."

Comparing these two sets of formulæ it will be seen that they differ very slightly, and mainly as respects the proportions employed. As we have said, we, and others, have succeeded admirably with Mr Burton's formulæ, and Captain Abney says of the other that failure with it is well nigh impossible. Here the process of silvering glass rests at present.

The above, from the *British Journal of Photography*, may be found useful in connection with the several excellent processes for silvering glass as given in SCIENTIFIC AMERICAN SUPPLEMENT, No. 105.

## GASTROTOMY.

DR. F. TRENDELENBURG reports in the *Wiener Med. Presse* another successful case of gastrotomy to be added to the hitherto unique case of Verneuil. A boy aged seven years, the subject of impassible stricture of the œsophagus from swallowing caustic potash, had fallen into extreme marasmus. Gastrotomy was performed without bad effects, and two days afterward nourishment could be introduced into the stomach through the small resulting gastric fistula. A small drainage-tube of the thickness of the little finger was introduced into the fistula, into which was passed a thicker glass tube, having attached to it an elastic gum catheter reaching to the mouth. When the boy wants to eat, he chews his food and expels the masticated mass through the tube into the stomach. Four months after the operation, the boy's weight had increased by a fourth.

BEDSIDE TELEPHONE IN FEVER HOSPITALS.—A writer in the *British Medical Journal* makes the following suggestion: That the instrument in question should be used for convalescent patients within fever-wards to converse with their friends to whom immediate access is necessarily denied on account of infection. A telephone can easily be carried from bed to bed in a ward, and the corresponding instrument might be fixed at any office at a distance. In our opinion this is a good and humane idea.

BOGUS DIPLOMAS.—Robert D. McClure, of Philadelphia, convicted of forging a diploma of veterinary surgery, has been sentenced to nine months' imprisonment and a fine of $200.

THE UNIVERSITY OF PENNSYLVANIA, Medical Department, has "received about $42,000 in fees from the students during the past five months; enough not only to pay all salaries and all the running expenses of the school, but also to fit up all the laboratories, and leave a small surplus over and above all expenses."

ABOUT two million pounds of horse flesh are annually consumed in Paris, and the demand is steadily on the increase.

## LECTURES ON PARALYSIS AND CONVULSIONS AS EFFECTS OF ORGANIC DISEASE OF THE BRAIN.

*Delivered at Bellevue Hospital Medical College, New York.*

By C. E. BROWN-SEQUARD, M. D., ETC.

### LECTURE VIII.

GENTLEMEN—Yesterday, you will remember, I was speaking of loss of consciousness as an effect of a peculiar alteration in the circulation of the brain. I proposed long ago to explain the loss of consciousness that occurs in an attack of epilepsy by attributing it to the contraction of the blood-vessels in the cerebral lobes. Contraction does take place, and it is a part of the epileptic attack. The same thing occurs in the blood-vessels of the face, and the face becomes pale. There is no doubt that a spasm of the muscular walls of the blood-vessels exists in the beginning of all attacks of epilepsy.

Although, theoretically, the cerebral convolutions contain the organs of consciousness, the will, and the mental faculties; although the contraction of the blood-vessels is clearly a cause of the cessation of cerebral activity, and there is no doubt that the cessation of circulation exists, it is certain also that it is not simply on account of this cessation of circulation that the loss of consciousness occurs.

In the first place, if we galvanize the two sympathetic nerves of the neck, thereby producing the greatest contraction that can take place, causing complete cessation of the circulation in the convolutions of the brain, we do not find that this condition alone is sufficient to produce loss of consciousness. There is certainly disorder in the animal's brain, but there is no complete loss of consciousness.

Secondly, if we cut the four large vessels that supply the brain, arresting the circulation at once, the loss of consciousness is never immediate. In most attacks of epilepsy the loss of consciousness is immediate. In some individuals there is no appreciable time between the aura and the loss of consciousness. So the loss of consciousness takes place before the cessation of the circulation can have time to produce its effects. We cannot therefore look upon the contraction of the blood-vessels as the cause of the loss of consciousness.

I call your attention—especially those of you who are desirous of making investigations—to the fact that it is not even certain that the view we all entertain is correct, that the function of an organ is lost, especially in the brain, when the circulation in that organ stops. There are facts that are in opposition. In cholera, for instance, the circulation in the brain is at times almost *nil*. After death the blood is found exceedingly black and frequently congealed; it does not contain any marked amount of oxygen, certainly infinitely less than is essential for its nutrition, yet the activity of the brain may continue for days without a diminution of the mental power.

I know that we can explain this fact otherwise than by admitting that a certain amount of nutrition is necessary for the activity of the tissues. It can be said that in cholera a poison exists in the blood that may serve for the nutrition of the brain, but such a supposition is absurd. However, it is the only way in which to explain the fact that the brain can go on with its activities without nourishment from the ordinary constituents of the blood that nourish it in ordinary circumstances.

When a man or animal is decapitated death takes place, and the brain is immediately emptied of its blood. In that case, as well as in the case in which we cut the four large vessels, there is no circulation in the brain, and we all admit that it is owing to the want of blood in the brain that that organ ceases to act. That view is not entirely correct. Why should the brain retain its activity in cholera with such a condition of the blood as exists in that disease? Why, then, when a man is bled to death, should the cerebrum cease to act simply because there is no circulation there? We must admit that the causes, whatever they are, that produce contraction of the blood-vessels of the brain, also at the same time cause an irritation which stops the activity of the brain, just as when we prick the medulla oblongata the animal falls down, with loss of power, and the heart ceases to act, but the activity of the brain is lost without change in its circulation. Suppose the heart continued to beat and the respirations continued; there would still be circulation, but the cerebral activity is lost. A change can immediately take place in the brain so complete as to stop its action instantly.

The action is like galvanism of the par vagum, producing stoppage of the heart. Certain cells in the brain are stopped in their activity by the irritation. If these facts be so, you can easily understand how it is that in cholera, though the blood ceases to circulate, there is no loss of consciousness, for there is no irritation to interfere with the activity of the cells. When you cut the vessels some irritation is started, which stops the activity of the brain cells.

I bring these points up to show you that a great deal yet remains to be investigated concerning them and many others.

We all admit that muscular irritability diminishes when the muscles are not used. The muscles certainly waste away when they are not used, but this wasting may be due to some other cause than the mere rest. There may be an irritation that alters the nutrition. In hysteria, for instance, the irritability may not be altered when there is complete paralysis. I once saw a young lady from London whose right arm was completely paralyzed, and in which there had been no movement for two years. The muscles were just as well nourished and responded as easily to galvanic stimulation as those of the other or healthy arm. There had been absolute rest, except perhaps slight movements during sleep, so that muscular inactivity is not in itself a sufficient cause of wasting. Wasting comes from an irritation that produces changes in nutrition. Thus in some cases of disease of the brain or spinal cord the muscles waste away very quickly. I have seen the muscles reduced to half their normal size in a week. If there is muscular wasting you may be sure that there is some secondary change in the brain and spinal cord. I bring these points out thus prominently on account of the seeming difficulty in distinguishing a simple cessation of activity and a loss of power. The symptoms in disease almost always appear from an irritation that causes or stops activity.

Returning to loss of consciousness, I will say, in regard to attacks of epilepsy, of syncope from emotion, or loss of consciousness due to poisons, as morphia or other narcotic remedies, it is due to cessation of activity. When rapid cessation of activity of the brain is produced, it is sure to be due to an inhibitory influence of the same kind as we get when we prick the medulla oblongata. There is an inhibition of cell activity which may last or not, according to circumstances.

I now pass to another point. I said yesterday that there is very frequently, in cases of convulsions due to brain disease, an aura. It is important, if possible, to find this out, for if you discover the aura you may have means of stopping the attack. In this way you may not only stop one single attack, but a series of attacks, for each attack of the kind produces changes that predispose to another attack.

Now, as regards our means of preventing an attack. For centuries past means have been resorted to for preventing the occurrence of these attacks. Galen proposed to put ligatures on the limbs for this purpose. Suppose, for instance, that the aura was in the finger. Galen and many others applied a ligature to the arm, with the idea that there was something which was going to pass from the finger up the arm to the brain, and there produce disorder. Such an idea is, of course, absolutely false. We very frequently succeed with a ligature on the arm, when the aura is there, in preventing epileptic attacks, but not because we prevent the passing of something to the brain. In reality, we send an irritation to the brain which stops an irritation already there, and which, if undisturbed, would cause the attack. It is the same thing as in disease of the spinal cord, where, when we take hold of the big toe and press it downward, we sometimes stop convulsions that were beginning to appear in the lower limb.

In spinal epilepsy the convulsions are often very violent, and may be produced by the slightest touch. In many of these cases, especially in certain forms, we may often produce complete relaxation of all the muscles by this simple procedure, simply pulling down the great toe. There is an arrest of the morbid action of the cells in the spinal cord produced by irritation of the nerves in the joint of the big toe. Whenever convulsions exist you can witness these results of irritation.

The same thing may happen when the disease is in the brain, as well as when it is in the spinal cord. Disease in the brain produces sometimes muscular contractions and sometimes sensations. It is just the same as when pressure on the ulnar nerve, or funny bone as it is called, causes a sensation in the fingers. A ligature, in the cases we have mentioned, is not essential: a simple pressure may be sufficient.

As soon as I came to hold the view that it was the irritation of the skin that stopped the convulsion, I tried other means to produce the same effect. Extreme cold, as the pressure of a lump of ice to the part, or heat, or pinching, may be sufficient to arrest the attack where the aura is known. Patients often are able themselves, by moving the limb rapidly as soon as the aura comes on, to stop an attack. An irritation at the periphery may act on the brain and stop the convulsion. This irritation may even succeed when it is applied to the other side from that on which the aura occurs, so that an irritation starting from any point, but especially near the locality of the aura, may sometimes stop the convulsion.

As regards other forms, if an aura starts from the stomach, anything which irritates it, as a strong emetic or a purgative that will exert rapid action on the stomach and intestinal muscles, may ward off the epileptic seizure. Pressure on the abdomen or a galvanic shock may prevent the attack in many cases.

If the patient have simply an undefined sensation of uneasiness, with no distinct place in which the aura originates, an irritation of the skin of the neck or between the shoulders may be of service. Irritation may be made in the form of a lump of ice, a blow, a galvanic shock, etc. These means may be varied almost infinitely. Any medicine which acts with great power on the stomach or bowels, or upon the nervous system, may be of benefit in such cases.

A good ordinary remedy is three or four grains of carbonate of ammonia in a drachm or drachm and a half of tincture of columba or gentian. Taken pure, it is, perhaps, too strong, and may burn the throat, but it may be diluted. Such a dose may arrest an attack, but it must be taken immediately.

Running, jumping, etc.—anything that may produce a change in the circulation—may be of service in cutting short an attack. You cannot know *a priori* which means will best work on the patient, but, looking carefully, and trying one after another the various means, you may find the one best suited to the case. If you save the patient from one attack you may save him from a great many, and perhaps in this way cure him entirely.

The combination of three medicines together I have found to have considerable more power than the use of one or two of them alone. If you use the bromide of potassium you must use it with the bromide of sodium or ammonium, or the iodide of potassium or ammonium. They act thus with far greater power than when uncombined. It is essential to add the ammonium bromide when the other bromides are employed. It is also essential to have some means of counter-irritation applied at the place of the aura. When the aura starts in the finger I have applied a circular blister, like a ligature. A blister over the forearm is sometimes useful. In two cases I have succeeded wonderfully by applying a blister around the finger. One of these cases was published in the *London Medical Times* in 1861.

There is, therefore, a series of means which can prove successful in preventing attacks in these cases. Now, as I said in the last lecture, if we have a means by which we can do so much in controlling epilepsy, why should we not be able to do the same in paralysis, which is essentially the same in its method of production?

I now come to speak of this point more particularly, but before doing so I have to say a few words more as regards the doctrine of the production of paralysis and convulsions now advanced, and of those I have to substitute in place of the generally admitted theories.

The facts that I have mentioned in my lectures seem to be quite in opposition to the views held by most if not all physicians. When, for example, paralysis exists in the right arm, and disease is found in the left convolutions, it is admitted that the centers of will power have been destroyed, and it is natural for the arm to be paralyzed. In the same way, if we cause irritation in any part of the voluntary motor apparatus, as the convolutions, and slightly inflame them, and the patient is attacked with convulsions in the right arm, it is quite natural, according to the accepted theories, to look upon the irritation there as having produced the convulsions, and having put into play the activities of the part in which the irritation exists. These two cases of paralysis on the one hand and convulsions on the other, seem to be in perfect harmony with what is thought to be established. But, as I have said many times, we may not only find the same thing taking place upon the opposite side, but upon the same side as the disease. The theory cannot apply in such cases. Besides, we may see the same thing when the disease commences in those

parts of the brain which will not produce movements when galvanized, and which do not belong to the voluntary motor apparatus.

Take, for example, the posterior lobes, disease in which, according to the admitted theories, should never produce paralysis or convulsions, but it does often produce paralysis and convulsions. What are the explanations given by physicians and physiologists of these cases which are against their views? They have been very few and very timid, and I think that I myself have put forward these explanations very strongly in opposing the admitted theories. Some of these cases may be explained by my view. It is quite evident that when we make an autopsy in a case in which there have been both paralysis and convulsions, and find disease in the posterior lobe of the brain on the opposite side, the disease is situated there. We are absolutely certain that the disease is at that point. It may be said, What proof is there that there is no disease elsewhere? There may be disease in the voluntary motor apparatus which is undetected when we examine in the way we usually do at an autopsy. We cannot spend days in examining every minute part of the brain tissue with the microscope.

There are many cases which answer this objection. If we find a patient stricken down with symptoms of hæmorrhage in the brain: he had no evidences of brain disorder previous to this attack which occurs suddenly. He has paralysis and convulsions in the right arm and he dies within a few hours, as such may be the case with a very limited hæmorrhage. We make the autopsy and find the posterior lobe to be the seat of the hæmorrhage. Can you admit that there was disease elsewhere? What kind of a disease could have been produced so quickly, or could have produced the paralysis found in the arm, at the same time as the symptoms of hæmorrhage occurred? In such a case we cannot say that the symptoms depended on some other disease that we do not see. Why should not the same thing apply when the paralysis and convulsions are on the side of the body on which they ought to be, according to the admitted theories?

There are a great many cases besides hæmorrhage which prove the same thing. Embolism of the arteries may act in the same way. In such a case the autopsy shows nothing else besides the embolism and surrounding congestion. If the lesion is in a part which does not belong to the voluntary motor apparatus, we must admit that the paralysis and convulsions were due to the disease we see and not to one that we can only imagine. Other instances yet might be given, but time presses and I will not go into them.

There is still another series of explanations which is very much needed to sustain the admitted theories. For instance, when the disease is located in a part, and sometimes a large part, of the supposed voluntary motor apparatus, and there is neither paralysis nor convulsions. How is it they have not been present? It might be said—I do not say it has been said—that paralysis has not appeared because only a part of the voluntary motor apparatus is destroyed. It may be and is so in some cases where the disease is slight in extent. But how is it that there may be no paralysis and convulsions when a great part of the voluntary motor apparatus is destroyed? Then it might be said that, though apparently diseased, enough tissue is left to transmit impulses, and be able to act. In softening after embolism it may be that the nervous tissue remains active, although it has undergone considerable alteration. The same thing may be true likewise in cases of tumors causing pressure on the brain. There may be simple atrophy of tissue without any loss of function.

This explanation will pass for a number of cases. It is certain that nerve fibers have as an essential element the cylinder axis, and this part may remain active though there is pressure on it. It may be so, but it is not at all proven; and, then, what of those cases in which every part of the nervous tissue, axis cylinder and all, has been entirely destroyed? There are forty or fifty of such cases in which disease has struck the base of the brain, or the convolutions, and in which no tissue was present that was not completely eaten up by the disease. We should expect not only loss of function, but that loss of function should be complete.

There are, then, two kinds of cases, those in which the tissue is altered and those in which the tissue is not there. In a number of such cases there has been no paralysis and no convulsions. It is clear, therefore, that there are a great many facts which cannot be explained by and which are in direct opposition to the generally admitted views.

What then is the theory which we are to admit in place of the generally accepted views as regards the production of paralysis and convulsions?

I have already often said that paralysis and convulsions appear from a mechanism alike in both cases, no matter how different one symptom is from the other. If you admit, as I do, that the cells of gray matter of the brain are endowed with different functions, then the explanation is easy. The cells which serve for moving the right arm are scattered in the brain, as well as are the cells that serve for any special function of the brain. These scattered cells belonging to any particular function are connected together by fibers, so as to be enabled to act in harmony with one another.

Suppose that the cells being so distributed, an irritation comes from the bowels in a certain individual; the irritation is transmitted to certain parts, and instead of going to certain other parts, it meets, in the part to which it has been transmitted, either with cells that are able to produce voluntary movement, or those which are able to produce movements by reflex action. These are different kinds of cells that have two distinct kinds of actions, as many facts show. If the irritation goes to cells capable of producing voluntary motion of the arm, for instance, that irritation produces the same effect when it strikes those cells as would an irritation of the *par vagum* by galvanism produce on the heart. The cells are inhibited and the heart ceases to beat, and just so these cells that move the arm have their activity suppressed, and paralysis occurs. If, however, an irritation starting from the bowels acts on those cells which serve for the production of reflex movements, whether they be in the base of the brain or elsewhere, these cells are put in play and convulsions occur. Identically the same phenomena occur when there is disease in the brain itself as when the irritation starts from the bowels.

An irritation starts from the posterior lobes, for instance; it spreads in the brain, and there acts on those parts that have a morbid sensibility. They would not be so acted upon if they were in a normal condition. If these cells, wherever they are, are those that serve for the production of voluntary motion, as for the arm, they are inhibited in their action, and paralysis of the arm is the result. If, on the contrary, the irritation, originated at the same place, reaches cells that have the power of producing reflex action, convulsions will be produced. There is the same element in both cases; there is an irritation starting from a particular place and traveling to cells at a distance; there the irritation causes an inhibition or an excited activity, and produces either paralysis or convulsions.

If you pass in review all the facts that I have given you, and what you will observe for yourselves, you will see that there is nothing that cannot be explained by this theory.

Take an irritation starting from this same posterior lobe and exerting an action on those cells that serve for the production of speech. The center for this faculty, according to the old views, lies far from the starting point of the irritation. The irritation is spread and reaches the cells in a more or less morbid state, inhibits their action, and aphasia appears.

I have not time to dwell longer on my opinions to make them better understood, but I will simply say that paralysis, aphasia, or loss of function in any part of the brain can occur by attacks as well as convulsions can occur in attacks. This is in perfect harmony with the views I hold.

The vision, the hearing, the expression of ideas by speech, voluntary motion of the arm, leg, and so on, may be affected with paralysis by attacks. Not only in cases of paralysis of this kind that occur in attacks, but also in those cases where the paralysis persists, there exists something of this kind of action. The objection to this would be: how is it that such a power can be kept inactive for so long a time as the inactivity exists when the paralysis is persistent? In many cases, however, of paralysis from organic disease of the brain, there has been a sudden change for the better. Some cases have even been quite cured while the same severe lesion that produced the paralysis persisted. And so it is in any case, in loss of any function of the brain. Although an organic disease that causes paralysis continues to exist, the paralysis disappears.

So then it is proven that paralysis, or amaurosis, or aphasia, or any other loss of function does not depend on the destruction or loss of brain tissue.

We know perfectly well that we can produce in animals in many instances the arrest of an activity of cells not only in the heart or respiration by irritation of certain portions of the base of the brain, but in other functions. So we know, clinically, that an irritation in the bowels may produce an arrest of activity in the cells that serve for sight. By irritation we may arrest the activity of the cells that serve for sight, or for any or all the mental faculties; the will, and, indeed, any nervous activity, may be suddenly arrested by irritation.

There are two cases on record of hæmorrhage in the upper part of the spinal cord, parts from which there could be no pressure exerted on the brain, in which loss of consciousness occurred. There was loss of power of all the functions of the brain, motion, sensation, and will power, and certainly there was no pressure on the brain, but simply an irritation started from a distance. In these cases consciousness was recovered.

Sometimes we may produce death rapidly, and, therefore, stop all activity of the brain, by a mere prick. We can also produce a persistent amaurosis by a mere prick of the corpus restiformis. There is no direct connection between this body and the eye, and, nevertheless, the amaurosis persists while the animal lives. I have had an animal live in my laboratory, with loss of sight produced in this way, for two years after the injury. After a time an alteration in the retina occurred, but this was long afterward.

We can also produce loss of all sensibility and of all the will power by a mere prick in the spinal cord. In some cases we may produce in this way anæsthesia on the opposite side of the body and loss of will power on the same side.

In some cases of disease of the brain the pulse is weakened and irregular while the patient lives. This is due to an arrest of the action of the heart from the disease in the brain. If the action of the heart can be so persistently modified, why may not different regions of the brain be affected in a similar way?

In disease of the brain, in a like manner, the reflex activity of the cells in the spinal cord may be inhibited. The sphincters of the rectum and bladder may be permanently paralyzed. The same thing may take place in the cells that control voluntary movements.

Now, from what has been said, what are the conclusions reached as regards treatment? As my time is over, I can only say a few words. The principal point is that you are to fight disease of the brain by means of irritation applied to the skin in the parts affected. Suppose, for instance, the arm is paralyzed; then apply the irritation so as to restore the activity of those cells that serve for voluntary motion of that limb. Place the irritation directly on the parts affected. The same means may be applied to the treatment of paralysis as apply to the treatment of an aura. Metallic plates applied to the skin will sometimes cure anæsthesia. The passage of a needle might have the same effect. In a few words, the means are to be applied to the parts affected.

## LOSS OF BRAIN SUBSTANCE, WITH RECOVERY.

By M. G. Parsons, M.D.

I was called November 23d, 1877, to see William S——, aged eighteen, German descent, who had been helping to saw wood with a circular saw driven by a horse power. By pinching the saw in some way, the saw, together with the balance-wheel and the entire frame which held it, was thrown from the foundation on which it rested, while running at a high rate of speed, striking the patient upon the top of the head, ranging from back to front, in a line from the right ear to the left eye, making an incision of about five inches long through the scalp and integument covering the forehead, and through the outer table of the skull of about four inches, and through the inner table two and one-half inches. The accident occurred at ten o'clock A. M., and I did not see him until dark that night. During the time, and until the wound was dressed, there must have escaped at least five or six drachms of brain substance.

Dr. Ormsby kindly assisted me in the operation, which was done by carefully removing the spiculæ of bone from the wound, several pieces of which were taken from the opening through which the brain escaped. In all about fifteen pieces of bone were removed, some of which were picked out of the mangled portion of the brain, which, together with his excitement, caused considerable brain to escape during the operation. After removing all the loose bone, we drew the wound together with sutures, leaving the lower portion of the wound open for drainage. The operation was performed without an anæsthetic. Applied warm water dressings, gave brandy and morphine. Pulse ranging for the next twenty-four hours from forty to sixty, quite irregular most of the time. I saw the patient next day at four A. M. and twelve M. I found him quiet, pulse sixty, and more regular; had taken some nourishment. Bowels constipated, and it was with much difficulty that I succeeded in getting them opened, not until he had taken five or six ounces of sulphate magnesia. He suffered considerable pain, but was only unconscious during the first three days, and only at intervals. I visited him every day for four days; used carbolic acid dressing after the first night. Visited on the sixth day again, and found him convalescing rapidly. Dismissed him with orders that if any unfavorable symptoms should occur to inform me at once. All the treatment I gave him was bromide potassium, in fifteen-grain doses, every three or four hours, for the first three days. The patient came to town on the fifteenth day, a distance of ten miles, in a lumber wagon, and had not had an unfavorable symptom since the third day after the accident. I removed the two remaining stitches after he came to town. There is no depression and no tenderness in the region of the wound. The patient is now at work, and says he will go to the next war, feeling perfectly safe.—E. J. B., *in Jour. South. Ill. Med. Ass.*

## AMPUTATION OF ARM WITHOUT LIGATURES.

By R. H. Milner, M.D.

John Boyd, Jr., and Olmstead Greene, colored, were employed in blasting. They had bored a hole about two inches in diameter to the depth of twelve feet in the solid rock. This was charged on the evening of the third of March. On attempting to fire the charge on the morning of the fourth, it was found that the fuse had become saturated with water at some point, and would not carry the fire to the powder. Against the standing order of Mr. Malone, they proceeded to bore out the charge to make room for another. Unfortunately, just as they were about to succeed in this hazardous undertaking, the drill, an iron rod one and one-half inch in diameter and twelve feet long, struck fire and ignited the charge. As both men had a tight grasp on the drill, which they were working with their hands, these members were literally torn to pieces. Boyd fared worst, losing both hands, the right being removed at the junction of the lower and middle thirds of the forearm. The left humerus was also fractured about the middle. The right arm was amputated first, and no trouble was found in finding and ligating the arteries; but on removing the left and slacking the tourniquet, it was found that no blood, with the exception of a little venous oozing, flowed. Nothing approaching the spurting of an artery could be seen, even after the tourniquet had been entirely removed. A most diligent search for the arteries was entirely futile. The patient was left with a competent attendant, while his fellow sufferer was attended to. At the end of two hours another and more thorough search for the arteries was made, with no better success. The stump was then dressed with interrupted suture, Maltese cross, and bandage in the usual manner. The fracture was treated by placing the arm in a tin trough. The stump of this arm healed sooner than did that of the right, the healing of the latter being delayed by suppuration, depending on extensive powder burns on the arm from the seat of amputation to the shoulder. There was at no time any hemorrhage from the left arm, nor was there any sloughing of the flaps. That the circulation was not interfered with by the fracture of the humerus is certain, as the pulsation of the brachial artery could be felt as far down as the elbow.—E. J. B., *in Phil. Med. Times.*

## SOLIDIFICATION OF ETHER.

Shortly after the French Revolution, Fourcroy and Vanquelin made some experiments in Paris upon the solidification of ether; as the results of these trials they asserted that ether commences to solidify at —31°, and concretes entirely into a solid mass at —44°. This assertion was entirely erroneous. Some years later the great chemist Thénard repeated the experiments, and found that ether remained still liquid even when submitted to the intense cold which is represented by —90° of the centigrade thermometer, and an English chemist, named Mitchell arrived at the same conclusion. Quite recently Mr. Franchimont has succeeded in accounting for the discrepancies in these two results. He has proved that Thénard's assertion is quite correct as regards pure ether, or what is termed anhydrous ether, or "absolute ether." But when the ether contains a certain quantity of water, which is very frequently the case, the results are different. Ether that contains a little water, but no alcohol, produces small crystals when submitted to a temperature of —31°, and as the cold increases these crystals do not augment in size or quantity. They are simply crystals of *ice*. However, Mr. Franchimont never found this hydrated ether become a solid mass even at —44°.

## ESTIMATION OF CASEINE AND FAT IN MILK.

J. Lehmann gives a new process for this purpose: Five grammes of milk diluted with an equal weight of distilled water are allowed to flow slowly from a pipette on to a porous earthenware plate standing over concentrated sulphuric acid, but covered with a clock-glass to prevent the evaporation of the milk. The pores of the plate must be so small as not to admit the passage of the smallest milk globule, the diameter of which is 0·001 to 0·025 of a millimeter. In the course of two hours the serum of the milk will be absorbed by the porous plate, leaving behind all the caseine and the fat. This residue is removed by means of a sharp horn spatula, dried for two hours at 105°, and weighed. The fat is dissolved out by ether; the residue, consisting of caseine and mineral water, is weighed, then ignited, and the weight of ash deducted from the weight of caseine and ash. The amount of caseine given by this method is higher than that obtained by Hoppe-Seyler by precipitating with acetic acid.

Colored Fires without Sulphur.—A correspondent asks for information on this point, having had his attention called to the danger of mixing the usual compounds of sulphur, chlorate of potash, etc. A recent writer in a London pharmaceutical journal says that if the sulphur be previously washed and dried, the chances of accident are much lessened. Another writer would accomplish this by using shellac, instead of sulphur, as recommended by Braunschweiger in the *Journal of the Chemical Society*. Better colors are produced, sulphurous vapors are avoided, and the mixture is free from the risk of spontaneous ignition. The formulas alluded to have been tried and found to give great satisfaction. The following are the proportions for the three leading colors: *Red*—Nitrate of strontia, 9 parts; shellac, in powder, 3; chlorate of potash, 1½. *Green*—Nitrate of baryta, 9; shellac, 3; chlorate of potash, 12. *Blue*—Ammonio-sulphate of copper, 8; shellac, 1; chlorate of potash, 6 parts. It must not be understood that these ingredients may, without danger, be powdered together in a mortar, or that they may be mixed carelessly. The salts should be dried on a plate or shovel, powdered separately, and then mixed with a spatula on a sheet of paper.

## THE CHEMICAL COMPOSITION OF CALIFORNIAN WINES.

By W. IVISON MACADAM, Lecturer on Chemistry, Edinburgh.

UNTIL lately the principal part of the wines obtainable were those grown on the continent of Europe. Within the last few years, however, several new countries have forwarded small consignments to the British market.

For the proper growth of the wine vine it is necessary that the climate should not be liable to rapid changes of temperature, for although a hard frost in the winter, when the sap is not ascending, does no damage but rather good to the plant, yet during the spring months the vine must not be exposed to sudden frosts, else the tender fruit branches will be liable to be frosted and their proper growth damaged or permanently destroyed It is also necessary that the vines should not be exposed to heavy rains during the autumn months, as these deteriorate the fruit crop.

On the continent of America the State of California is particularly adapted to the growth of the vine, for although the temperature is somewhat low during winter, yet the spring, summer and autumn months may be depended on. For the last few years much attention has been devoted in the State to the growth of the better class of wine vine, and great improvement has been made in the vineyards by the introduction from Europe of plants and graftings of the Riessling, Malvoisie, Zinfandel, Orleans, Berger and other high class varieties. The wines manufactured are large in number and include white and red varieties, ports, champagne, etc.

Samples of port, malaga, sherry and a special variety called "Mount Vineyard" were obtained direct from the American vineyards, and submitted to analysis, when they gave the following results:

PORT.

| | |
|---|---|
| Specific Gravity of Wine | 1022·96 |
| " " " *minus* Alcohol | 1035·03 |
| Specific Gravity of Distillate | 977·01 |
| Percentage of Alcohol *by Weight* | 15·99 |
| " " " *Volume* | 19·00 |

*In One Imperial Gallon.*

| | |
|---|---|
| Total Dry Residue | 8439·90 grains. |
| " " " *minus* Ash | 8194·90 " |
| " Ash | 245·00 " |
| Grape Sugar | 833·00 " |
| *Fixed* Acid, calculated as Tartaric Acid | 249·90 " |
| *Volatile* Acid, calculated as Acetic Acid | 42·00 " |

*In* 100 *parts.*

| | |
|---|---|
| Dry Residue | 11·786 grains. |
| " *minus* Ash | 11·444 " |
| Ash | 0·342 " |
| Grape Sugar | 8·146 " |
| *Fixed* Acid, calculated as Tartaric Acid | 0·357 " |
| *Volatile* Acid, calculated as Acetic Acid | 0·060 " |

*Taste*, sweet.
*Color*, rich.

The specific gravity of this wine is higher than is usual in the case of Portuguese ports. This is due to the large amount of grape sugar, which also greatly increases the dry residue, which is fully 2 per cent. above the average amount to be obtained in "natural" ports.

MALAGA.

| | |
|---|---|
| Specific Gravity of Wine | 1053·56 |
| " " " *minus* Ash | 1073·27 |
| Specific Gravity of Distillate | 978·66 |
| Percentage of Alcohol *by Weight* | 14·25 |
| Percentage of Alcohol *by Volume* | 17·33 |

*In One Imperial Gallon.*

| | |
|---|---|
| Total Dry Residue | 14249·90 grains. |
| " *minus* Ash | 13974·10 " |
| Total Ash | 275 80 " |
| Grape Sugar | 10769·23 " |
| *Fixed* Acid, calculated as Tartaric Acid | 254·80 " |
| *Volatile* Acid, calculated as Acetic Acid | 47·60 " |

*In* 100 *parts.*

| | |
|---|---|
| Dry Residue | 19·321 grains. |
| " *minus* Ash | 18·948 " |
| Ash | 0·373 " |
| Grape Sugar | 14·602 " |
| *Fixed* Acid, calculated as Tartaric Acid | 0·364 " |
| *Volatile* Acid, calculated as Acetic Acid | 0·068 " |

*Taste*, sweet.
*Color*, good.

The amount of grape sugar is very large, which increases the weight of the dry residue and specific gravity of the wine.

SHERRY.

| | |
|---|---|
| Specific Gravity of Wine | 993·22 |
| " " " *minus* Alcohol | 1114·86 |
| Specific Gravity of Distillate | 978·83 |
| Percentage of Alcohol *by Weight* | 14·60 |
| " " " *Volume* | 17 70 |

*In One Imperial Gallon.*

| | |
|---|---|
| Total Dry Residue | 2701·30 grains. |
| " " *minus* Ash | 2536·80 " |
| " Ash | 164·50 " |
| Grape Sugar | 1129·03 " |
| *Fixed* Acid, calculated as Tartaric Acid | 292·85 " |
| *Volatile* Acid, calculated as Acetic Acid | 26·60 " |

*In* 100 *parts.*

| | |
|---|---|
| Dry Residue | 3·884 grains. |
| " *minus* Ash | 3·648 " |
| Ash | 0·236 " |
| Grape Sugar | 1·623 " |
| *Fixed* Acid, calculated as Tartaric Acid | 0·381 " |
| *Volatile* Acid, calculated as Acetic Acid | 0·038 grains. |

*Taste*, dry.
*Color*, pale.

This analysis agrees closely with Spanish "natural" sherries.

"MOUNT VINEYARD."

| | |
|---|---|
| Specific Gravity of Wine | 1016·29 |
| " " " *minus* Alcohol | 1035·89 |
| Specific Gravity of Distillate | 978·98 |
| Percentage of Alcohol *by Weight* | 14·00 |
| " " " *Volume* | 17·00 |

*In One Imperial Gallon.*

| | |
|---|---|
| Total Dry Residue | 6679·40 grains. |
| " " *minus* Ash | 6517·00 " |
| " Ash | 162·40 " |
| Grape Sugar | 5185·18 " |
| *Fixed* Acid, calculated as Tartaric Acid | 235·20 " |
| *Volatile* Acid, calculated as Acetic Acid | 32·20 " |

*In* 100 *parts.*

| | |
|---|---|
| Dry Residue | 9·389 grains. |
| " *minus* Ash | 9·161 " |
| Ash | 0·228 " |
| Grape Sugar | 7·288 " |
| *Fixed* Acid, calculated as Tartaric Acid | 0·336 " |
| *Volatile* Acid, calculated as Acetic Acid | 0·046 " |

*Taste*, sweet.
*Color*, pale.

A large amount of grape sugar present.

These results show that the percentage of alcohol in all of the wines closely resembles the amount generally found in "natural" European varieties, and that the acid, both *fixed* and *volatile*, is below the average; that the high specific gravities of the port, malaga, and "Mount Vineyard" are due to the presence of considerable quantities of grape sugar, which has doubtless been added to the wine so as to suit the taste of consumers. From the same cause the dry residues obtained from those three wines are considerable. In the sherry the whole of the results point to a wine very closely allied to the Spanish varieties of "natural" sherry. The ash in all the wines is small in amount.

In taste the sherry resembles the dry class of wines, while the port, malaga and "Mount Vineyard" are sweet to taste. The port has a rich color, while the sherry and "Mount Vineyard" are pale and bright. On account of the wines being somewhat new, they lack in a degree the bouquet of older wines, but doubtless when aged the ethers will be formed in larger quantities and supply what is at present wanting. They are good sound wines, and somewhat agreeable to taste.

The home consumption of these wines in the State of California is considerably above 2,500,000 gallons per year. The export in 1873 was 490,568 gallons, while for the first six months of 1877 the total amount sent out of the State was 452,392 gallons, thus showing a considerable increase. The most of the exported material is used on the American continent, while smaller amounts find their way to more distant markets. In 1876 Great Britain received 1,033½ gallons, being the first consignment, while Germany obtained 1,525 gallons.—*Pharmaceutical Journal.*

## EXTRACTION OF GALLIUM.

By LECOQ DE BOISBAUDRAN AND E. JUNGFLEISCH.

THE small proportion of gallium in the minerals containing it renders the preparation of this metal costly and laborious. The authors have followed a method which enables them to attach its preparation to that of a commercial product, the sulphate of zinc, and to operate at first industrially upon important masses. M. Leon Thomas has under their guidance treated 4,300 kilos. of the blende of Bensberg, the richest ore known. The pulverized mineral is roasted in a Perret furnace, when the gallium remains fixed, while the greater part of the indium is volatilized. The residue is treated with a quantity of sulphuric acid, sufficient to dissolve almost all the zinc, leaving, however, in the mass so much sub-sulphate of this mineral that the filtrate may be rendered turbid by cold water. We obtain thus commercial sulphate of zinc and a residue containing the gallium. This residue is redissolved in an excess of sulphuric acid. After the reduction of the per-salt of iron by means of metallic zinc, the filtrate is precipitated fractionally with carbonate of soda, the progress of the operation being watched with the spectroscope. The precipitates are redissolved in sulphuric acid, and a second reduction with zinc and a fractionated precipitation with carbonate of soda follow. All the gallium in the 4,300 kilos. of ore was thus concentrated in about 100 kilos. of still moist material. To remove the iron the reductions with zinc and the fractionated precipitations with carbonate of soda are repeated several times. The galliferous precipitate is redissolved in sulphuric acid, evaporated to the elimination of most of the excess of acid, and boiled with much water. The filtrate deposits a sediment containing titanic acid. The liquid, which is very acid and much charged with zinc, is treated with sulphureted hydrogen, mixed with acetate of ammonia, and anew treated with sulphureted hydrogen. Sulphide of zinc is thrown down along with gallium, which is thus freed from alumina. The additions of sulphate of zinc, of acetate of ammonia, and the currents of sulphureted hydrogen are repeated as long as the sulphide gives the rays of gallium. The sulphuric solution of the galliferous sulphides of zinc is carefully fractionated with carbonate of soda, and guided by spectral examination the zinc is thus exactly separated. Being again dissolved in sulphuric acid in the quantity exactly necessary, we further separate with sulphureted hydrogen a little cadmium, lead, indium, zinc, etc., and the liquid, largely diluted with water, is raised to a boil. By filtering when hot we collect a bulky sub-salt of gallium, which is immediately washed in boiling water, for on cooling it dissolves in its mother-liquor. This basic salt is very readily attacked by potassa, which leaves undissolved iron, indium, etc. The alkaline liquor, on treatment with sulphureted hydrogen gas, and then very slight acidulation with sulphuric acid, yields a deposit principally consisting of sulphide of indium. The very slightly acid liquid is next boiled with a large excess of water, when the sub-salt is again deposited. Metallic gallium is isolated by the electrolysis of the potassic solution of the sub-salt. The metallic deposit is only obtained advantageously under certain special conditions. The intensity of the electric current should vary according to the state of the liquid, but the surface of the negative electrode must be small in comparison with that of the positive electrode. If the metal is deposited in the cold, it often forms long rows of crystals resembling needles fixed to the electrode by one of their ends, and sometimes reaching 3 centimeters in length. Above 30° the metal flows in drops, which collect at the bottom of the electrode. The crude metal has been further purified by filtering it through dense linen, shaking it while hot with water acidulated with hydrochloric acid, and repeated recrystallization.

## DETERMINING POTASSA.

By A. CARNOT.

THIS method is a transformation of that made known by the author in the *Comptes Rendus* for July 31 and August 7, 1876, and June 25 and July 30, 1877, depending on the precipitation of the double hyposulphite of potassa and bismuth in an alcoholic solution. The new method consists in determining, by means of a standard solution of iodine, the proportion of hyposulphurous acid in an aqueous solution of the same salt. The iodine solution employed is decinormal, as recommended by Prof. Mohr—12·7 grms. of pure iodine being dissolved in water by the aid of about 18 grms. of potassium iodide, and the solution made up to 1 liter. The solution of calcium hyposulphite contains, per liter, 200 grms. of the crystalline salt. The solution of bismuth contains, per liter, about 100 grms. sub-nitrate, and a sufficient proportion of hydrochloric acid and alcohol. For each operation 1 grm. of the salt to be analyzed is taken, or a quantity which may contain at most 70 centigrms. potassa, and it is dissolved in about 10 c.c. of water. If the salt contains much sulphate, chloride of calcium is added (1 grm. of this salt dissolved in water, or a corresponding quantity of pure calcium carbonate dissolved in hydrochloric acid, is fully sufficient for 1 grm. of sulphate), and the mixture is left for a few minutes in order that the calcium sulphate may have time to precipitate. Into the same flask are poured successively 10 or 20 c.c. of the solution of bismuth, according as the quantity of potassa is presumably below or above 30 centigrms.; an equal volume of the hyposulphite of lime is next added, and, lastly, from 100 to 150 c.c. of concentrated alcohol. The whole is well stirred up and left to settle for a quarter of an hour. The precipitate of double hyposulphite, whether mixed with sulphate of lime or not, is collected on a filter and carefully washed with alcohol. The funnel is then set over a flat-bottomed flask, and cold water is poured upon it with the washing bottle, when the hyposulphite dissolves rapidly. The portion of calcium sulphate which may dissolve at the same time does not interfere with the subsequent operations. A little clear starch paste is then added to the solution, and a few c.c. of hydrochloric acid. The standard iodine liquid is then added with a burette, until a deep brown tint appears in the liquid. The volume of the iodine solution employed is then read off, and the weight of the potassa is thence calculated.

## THE VIBRATIONS OF MATTER AND THE WAVES OF THE ETHER IN SIGHT.

By M. FAVÉ.

IF we admit that all matter is endowed with a system of persistent vibrations, we are led to consider vision in a new light, for the transparent cornea, the aqueous, the crystalline, and the vitreous humor can be no longer regarded simply as concerns the refraction which they produce. It must be admitted that the vitreous humor exerts all the vibrations to be communicated to the optic nerves, and that these are able to select the vibrations which they are capable of executing to produce distinctly the sensation which remains an insoluble problem. By admitting that the waves of the ether communicate their motion to the synchronous vibrations of different parts of the eye, we may refer to physics certain facts hitherto considered as purely physiological. The eye, if closed for a time, sufficiently long not to experience any sensation of light, undergoes, nevertheless, the constitutive vibrations of its component matters, but in this state the vitreous humor does not impart to the nerves a *vis viva* sufficient to produce sensation. The eye, again, is opened and receives waves capable of augmenting certain vibrations of the vitreous humor, but time is required in order that the vibration may acquire the needful intensity. If the minimum intensity indispensable for sensation has been exceeded, and the eye is again closed, the sensation does not cease immediately, for the *vis viva* acquired must first be transferred to the ether.

## THE VIBRATIONS OF MATTER AND THE WAVES OF THE ETHER IN THE ACT OF EBULLITION.

By M. FAVÉ.

THE author, referring to Gay-Lussac's observation that water boils at a higher temperature in a glass vessel than in one of metal, and to his suggestion to prevent succussions in the distillation of sulphuric acid by putting fragments of platinum wire in the retort, states that he is in a position to explain these facts. The wave-lengths of the solar spectrum vary from 220 to 4,800 millionths of a millimeter. Each of the vibrations of matter which gives rise to these waves possesses a certain quantity of *vis viva* which is manifested by the effect of heat, only this heat is sometimes too small to be recognized by our instruments. In the solar spectrum the thermic action increases from its minimum in the violet to a certain distance beyond the red, after which it declines to a point where it disappears entirely. Thus the *vis viva* of the solar vibrations increases with their duration up to a maximum, after which it decreases. Hence, a distinction must be made between vibrations whose lengths differ, for two dissimilar substances cannot always communicate to each other all their excess of heat. From the fact that the ebullition of water is effected in an iron vessel and in a glass vessel, we may infer that both transmit to the water all the vibrations necessary to form its vapor, but if the ebullition takes place at a higher temperature in the glass than in the metal, it is because the glass requires a more elevated temperature than the tin plate to be in a condition to give to all the vibrations indispensable for watery vapor the necessary intensity. The system of the vibrations of the source of heat, if it is not in harmony with that of the vibrations of the vessel, may also retard ebullition. To these two causes it must be ascribed that ether, which over the naked fire boils at 44°, has been raised to 65° in the water-bath.

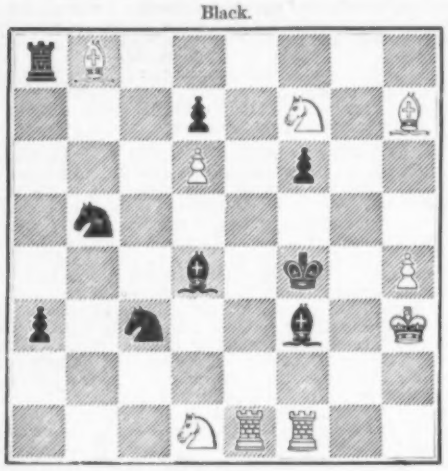
## SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department may be addressed to SAMUEL LOYD, Elizabeth, N J.]

PROBLEM No. 74. BY F. HEALY.

First Prize of the Manchester Meeting of 1857.

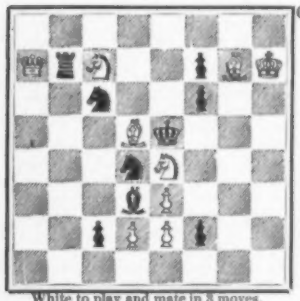
Black.



White.

White to play and mate in four moves.

### FRANK HEALY OF LONDON.



White to play and mate in 3 moves.
From Detroit Free Press Tourney.

YOU cannot form a fair estimate of the talent and skill of a composer from one or two of his problems for the reason that many of the very finest positions are apparently so simple of construction that we are surprised that they were not thought of before, and we have known very mediocre composers accidentally hit upon a very fine problem; to judge a composer fairly, therefore, all of his problems should be examined to see how many poor ones he has perpetrated.

We do not deny that other composers have made stratagems that will compare favorably with those of Mr. Healy, but such compositions are the exception to the rule and are above the average skill of their authors, while Mr. Healy's problems are all good, and show a beauty and clearness of idea and a neatness of finish that is characteristic of this great master. His problems are always dressed up in the best possible shape, leaving no possible room for improvement, as is generally the case with the average problem of the day.

We all have our own peculiar tastes and predilections and many will hold views contrary to ours, but we have never yet seen a poor problem by Mr. Healy, and would rate him as the most skillful and finished of European problemists, a full head and shoulders above any other composer that the old world has yet produced.

It makes but little difference which of his positions we select, a simple little idea, or a difficult stratagem like the following; we are sure to find the same graceful idea and artistic finish.

ENIGMA No. 43.—BY F. HEALY.

White.—K on Q 6, Q K B 2, R Q B 5, P Q B 3.
Black.—K Q 6.
White to play and mate in three moves.

ENIGMA No. 44.—BY F. HEALY.

White.—K on Q 2, R K 5, Bs Q Kt 8 and K Kt 4, Kt Q Kt 3, Ps Q Kt 6 and Q R 5.
Black.—K Q B 3, Kt Q 5, Ps Q Kt 2 and 4.
White to play and mate in four moves.

Mr. Healy is one of the few chess celebrities whom we have not had the pleasure of meeting, and cannot therefore speak so advisedly as we can of others whom we know personally, but his works do not strike us as the spontaneous creation of an overflowing genius, but rather bear the imprint of careful, conscientious, and, withal, wonderfully skillful workmanship. He is a most prolific composer, having created a great number of problems, but his works are so highly finished and show so much careful study that we can hardly believe that he is a rapid composer.

He has been so successful in the tournaments in which he has competed, that we find it impossible to give a record of his victories. We remember, however, that he carried off the first prize in the British Tournaments of 1857, 1858, and 1861, as well as other tournaments which will be duly noticed as we continue our record of prominent tournaments and matches. In conclusion we will add that Mr. Healy is a strong player who has taken part in many playing tournaments and can hold his own against the strongest players of Europe.

### THE DETROIT FREE PRESS TOURNEY.

OUR letter "Y" of the present issue is one of a set of three problems forming the letters "X, Y, Z," which have recently appeared as competing problems in the present Tournament of that enterprising chess department.

The time for competition in this as well as the Association Problem Tournament has expired and the anxious competitors are now awaiting the verdict.

In the Association Tournament upward of fifty problems have been entered, which is an excellent showing when we consider the short space of time allowed for competition.

### THE FOURTH MEETING OF THE BRITISH CHESS ASSOCIATION. 1857.

FROM Mr. Lowenthal's memoirs of the British Association Tournaments we learn that this meeting was held at Manchester, 1857, being the same year as the memorable first meeting of the American Chess Association that heralded the advent of Morphy and Paulsen.

A tournament was arranged between eight of the leading players—the prize being a set of Chinese carved chess men; but one game was contested between each round of players. In the first encounter Messrs. Anderssen, Boden, Lowenthal, and Pinder won respectively against Messrs. Harrwitz, Soul, Horwitz, and Brien. In the second round Messrs. Boden and Lowenthal threw out Messrs. Pinder and Anderssen.

In the last round, between Mesars. Boden and Lowenthal, one game was drawn, and Mr. Boden being unable to play conceded the prize to his opponent. This and the following meeting of the Association, in 1868, wherein the prize was also won by Herr Lowenthal, have always been looked upon as two of his most signal victories.

As we have previously mentioned, the prizes for the best set of problems of both of these tournaments were won by Mr. Healy. We give this week the positions which, under the motto of "Ludimus effigiem belli," received the prizes of 1857, although they are not up to Mr. Healy's usual standard of excellence.

FRANK HEALY.

### COCHRANE VS. STAUNTON.

THE following game is given as a specimen of the late Mr. Cochrane's style of play, although it is hardly as brilliant as some we have seen by this proverbially dashing player:

| MR. COCHRANE. | MR. STAUNTON. |
|---|---|
| WHITE. | BLACK. |
| 1. P to K 4 | 1. P to K 4 |
| 2. Kt to K B 3 | 2. P to Q 4 |
| 3. Kt x K P | 3. Q to K 2 |
| 4. P to Q 4 | 4. P to K B 3 |
| 5. Q Kt to B 3 | 5. P x K Kt |
| 6. Kt x Q P | 6. Q to K B 2 |
| 7. K B to Q B 4 | 7. Q R to K 2 |
| 8. Castles. | 8. P to Q B 3 |
| 9. P to K B 4 | 9. P x Kt |
| 10. B P x P | 10. Q to Q 2 |
| 11. K P x P | 11. R x P |
| 12. P to K 6 | 12. Q to Q B 3 |
| 13. Q to K R 5 | 13. P to K Kt 3 |
| 14. Q x B | 14. K Kt to K 2 |
| 15. Q to K 5 | 15. Q x B |
| 16. Q x R | 16. Kt to K B 4 |
| 17. Q B to K R 6 | 17. Q to Q Kt 5 |
| 18. Q x B ch | 18. Q x Q |
| 19. B x Q | 19. K x B |
| 20. P to K Kt 4 | 20. Resigns. |

### INTERNATIONAL TOURNAMENT.

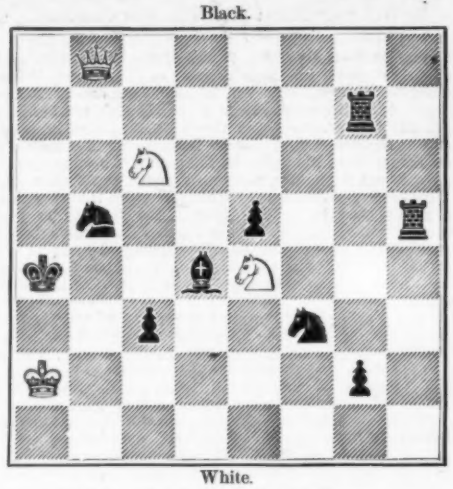
THE following is a game just concluded in the great international contest:

| MR. MONK, of Dublin. | MR. FRECH, of Washington. |
|---|---|
| WHITE. | BLACK. |
| 1. P to K 4 | 1. P to K 4 |
| 2. Kt to K 4 | 2. Kt to Q B 3 |
| 3. B to Q B 4 | 3. B to Q B 4 |
| 4. P to Q B 3 | 4. Kt to K B 3 |
| 5. P to Q 4 | 5. P x P |
| 6. P to K 5 | 6. P to Q 4 |
| 7. B to Q Kt 5 | 7. Kt to K 5 |
| 8. B x Kt ch | 8. P x B |
| 9. P x P | 9. B to Q Kt 3 |
| 10. Castles. | 10. B to K Kt 5 |
| 11. B to K 3 | 11. Castles. |
| 12. Kt to Q B 3 | 12. P to K B 4 |
| 13. P to K Kt 3 | 13. Q to K sq |
| 14. K to K Kt 2 | 14. Q to K R 4 |
| 15. P to K R 4 | 15. P to K B 5 |
| 16. Kt x Kt | 16. P x B |
| 17. P x P | 17. B x Kt ch |
| 18. R x B | 18. Q x R ch |
| 19. Q x Q | 19. R x Q |
| 20. K x R | 20. R to K B sq |
| 21. K to K Kt 2 | 21. P x Kt |
| 22. P to Q Kt 4 | 22. R to K B 6 |
| 23. R to K sq | 23. K to B 2 |
| 24. R to K B sq | 24. And black announced a win in 27 moves by queening a pawn. |

PROBLEM No. 75. BY E. HEALY.

First Prize in the Manchester Tourney of 1857.

Black.



White.

White to play and mate in three moves.

### SOLUTIONS TO PROBLEMS.

No. 68.—BY T. M. BROWN.

| WHITE. | BLACK. |
|---|---|
| 1. Q to Q B 7 | 1. K x R |
| 2. Kt to Q 3 | 2. Any move |
| 3. Q mates. | |
| | 1. B x R |
| 2. Kt to Q B 4 | 2. Any move |
| 3. Q or Kt mates. | |
| | 1. R to K sq |
| 2. Kt to K 6 | 2. Any move |
| 3. Q or Kt mates. | |

No. 69.—BY HENRY NORTHCOTE.

| WHITE. | BLACK. |
|---|---|
| 1. Q to Q R 6 | 1. Kt to K 4 |
| 2. Q to K 2 | 2. Kt to K B 6 |
| 3. Q x Kt | 3. Moves |
| 4. Q mates. | |

LETTER "L."—BY SCHOUMOFF.

| WHITE. | BLACK. |
|---|---|
| 1. Q to R 4 | 1. Kt to Q 3 |
| 2. B x Kt ch | 2. B x B |
| 3. Kt to K 4 mate. | |

ENIGMA No. 36.—BY LA BOURDONNAIS.

| WHITE. | BLACK. |
|---|---|
| 1. Kt x P ch | 1. B x Kt |
| 2. R to B 5 ch | 2. B x R |
| 3. B to K 4 ch | 3. Kt x B |
| 4. P to Q 5 mate. | |

ENIGMA No. 37.—BY LA BOURDONNAIS.

| WHITE. | BLACK. |
|---|---|
| 1. P Kts ch | 1. K to K sq (best) |
| 2. Q to Kt 7 ch | 2. K to B sq |
| 3. Q to B 6 ch | 3. K to Kt sq |
| 4. Kt to K 7 ch and wins. | |

### CHESS ON A LARGE SCALE.

MOST persons who have any acquaintance with the literature of chess have heard of the games said to have been played in the Middle Ages with living chess men. According to a news letter in the *Pioneer*, Lord Lytton has recently revived this amusement in India. During his visit to Mooltan last month his Lordship, after receiving and replying to an address from the municipality of the city, engaged, we are told, "in a novel game of chess with Colonel Millett. The chess board, if such a term may be allowed to a carpet of red and white calico with checkers a yard square, having been spread in front of the hall, chess men, men and boys dressed in opposing red and white uniforms appropriate to the various pieces, were marched in and took their places. Then by word of command each piece moved to the square indicated and a very lively game ensued, ending in an easy victory for the Viceroy." An Emperor of Morocco, who once indulged in a similar amusement, is said to have added a terrible realism to the game by causing all the pieces taken during the progress of the game to be beheaded.—*Pall Mall Gazette.*

The following is related in an old file of the *Canton Register* (1833):

"It is well known that the provinces of Shen-Se and Shan-Se contain some of the most opulent men in China. The natives assert that they have money heaped up like mountains; the chief money lenders in Canton are from these provinces. During the last years of the late Emperor, Kea King, a rich widow of the name of Chun, who resided in the district Tae-yuen-foo, had a son who went to all lengths in luxury and extravagance. He was a great chess player; but chess on a board or piece of paper, as the Chinese practice it, is a very meager though interesting game.

"Master Chun conceived a new idea. He had a floor of a large room painted as a chess board, with tables for himself and a friend on opposite sides. For chess men he purchased a set of beautiful female slaves, dressed them up in various colors, and made them perform by signal the duties of Knights, Castles, Pawns, Kings, Queens, etc. This high chess player saved himself the trouble of removing the pieces; at a given signal the captured men made their exit at the door.

"Of these proceedings the Emperor got intelligence, and, probably enraged that a rich subject should outdo him in luxury, he affected to be horribly offended at the idea of buying slaves to perform the office of chess men. He fined Master Chun three million taels (a million sterling), and transported him to the Amoor, or Black Dragon River, for life, telling him at the same time that he ought to be infinitely grateful that his brain-cup was not separated from his body."